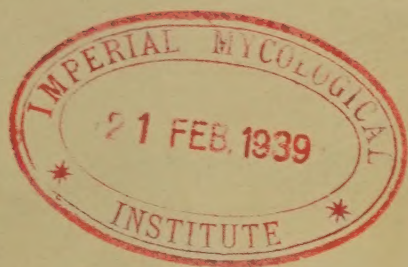


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1939

**PROGRESS REPORTS FROM EXPERIMENT
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QUEENSLAND

COTTON RESEARCH STATION, BILOELA.

PROGRESS REPORT FOR THE SEASON 1937-38.

BY

W. G. WELLS.

INTRODUCTION.

The following Report has been prepared from the reports submitted by Mr. L. M. Hodge, Manager of the Station, and Mr. W. A. R. Cowdry, Instructure in Cotton Culture, who conducted most of the technical observations connected with the experiments. The appended entomological notes have been courteously supplied by Messrs. W. J. Sloan and D. J. Lee, Assistant Research Officers in the Entomological Section of the Division of Plant Industry of the Queensland Department of Agriculture and Stock.

SEASON.

The season under review was more or less a continuation of the adverse conditions that ruled throughout the previous season at the Station. Although the total rainfall was just below normal, distribution was very faulty and extremely high temperatures were experienced at critical periods, which, in conjunction with a deficiency of subsoil moisture, seriously affected the normal development of cotton. Compared with the means of previous crop years, the growing season, as a whole, was characterized by periods of abnormally high temperatures, both by day and night, several of which were of rather long duration. One spell lasting through February and the early half of March was chiefly responsible for the poor yields obtained not only on the Research Station but throughout most of the cotton belt; previous to this heat wave, crop reports indicated that satisfactory yields were in prospect.

The winter rains were disappointing, the total registrations at the Research Station for the months of June, July and August being 2.67 inches, which is 1.38 inches below the mean for previous years, and for September no rain was recorded, which has occurred only twice during the past fourteen years. October, the recognised month for planting, opened with a continuance of dry conditions which prevailed through practically the whole month. From April to the end of October only 4.31 inches were recorded, as compared with a mean of 10.74 inches for the previous thirteen years over the same period. This reduction of 59.9 per cent. of the previous average precipitation meant that another cotton-growing season was being entered into with the serious disadvantage of no reserve subsoil moisture, and this deficiency undoubtedly had a great influence on the resultant harvest.

Early in November a rain group yielding 167 points was received which enabled planting to be commenced, but it was followed immediately by high temperatures and drying winds, so that the surface soil dried out quickly. The position was relieved later, however, by a rain group yielding 381 points, which allowed planting to be completed. Further rain occurred on December 15th, when 149 points fell over a period of three days. Thereafter the weather became very hot, with high humidity, and continued so through January, broken only by three light storm groups, totalling 3.20 inches.

February proved disastrous, not only to cotton but to all crops at the Station and in the adjacent district. Only .05 inches of rain were received in isolated showers and during the succeeding weeks of drought and heat the plants suffered to such an extent that all cotton wilted and shed most of the crop. These conditions continued into March without interruption until the 21st, when steady, soaking rains covering a period of 6 days and yielding 318 points put a definite ending to the drought.

Warmer weather than is generally associated with April followed, with the result that a quick development of growth and square formation occurred. May opened cloudy, and a succession of very heavy falls of rain were received during the last fortnight, making a total of 704 points and constituting a record for that month for the Station since its inception. The remaining winter months were cloudy and mild, and the first killing frost was not experienced until August 3rd.

SEASONAL OPERATIONS.

The seasonal operations consisted mostly of a continuation of experimental and investigational work described in previous reports, which includes soil moisture and nitrate studies, varietal testing, spacing and thinning, rotational cropping, pasture rotation and selection and progeny testing. In addition, hybridization work was commenced with the Miller variety, an American Upland cotton, and a U.4 strain introduced from Barberton, South Africa.

BREEDING WORK.

A continuation of the Miller breeding work is reported, and while the season was against the highest standards being adopted in testing the progenies, particularly in regard to yield, satisfactory progress has been made, and some promising progenies are being increased. This variety continues to give very satisfactory results throughout the Callide Valley and is fast becoming the leading competitor to Lone Star, the variety mostly in demand at present. The Australian

RAINFALL AND TEMPERATURE GRAPH - BILOELA.

SEASON 1937-38.

THREE-DAY
MEANS { SEASON 1937-38 —
 { MEANS FOR 12
 { PREVIOUS YEARS

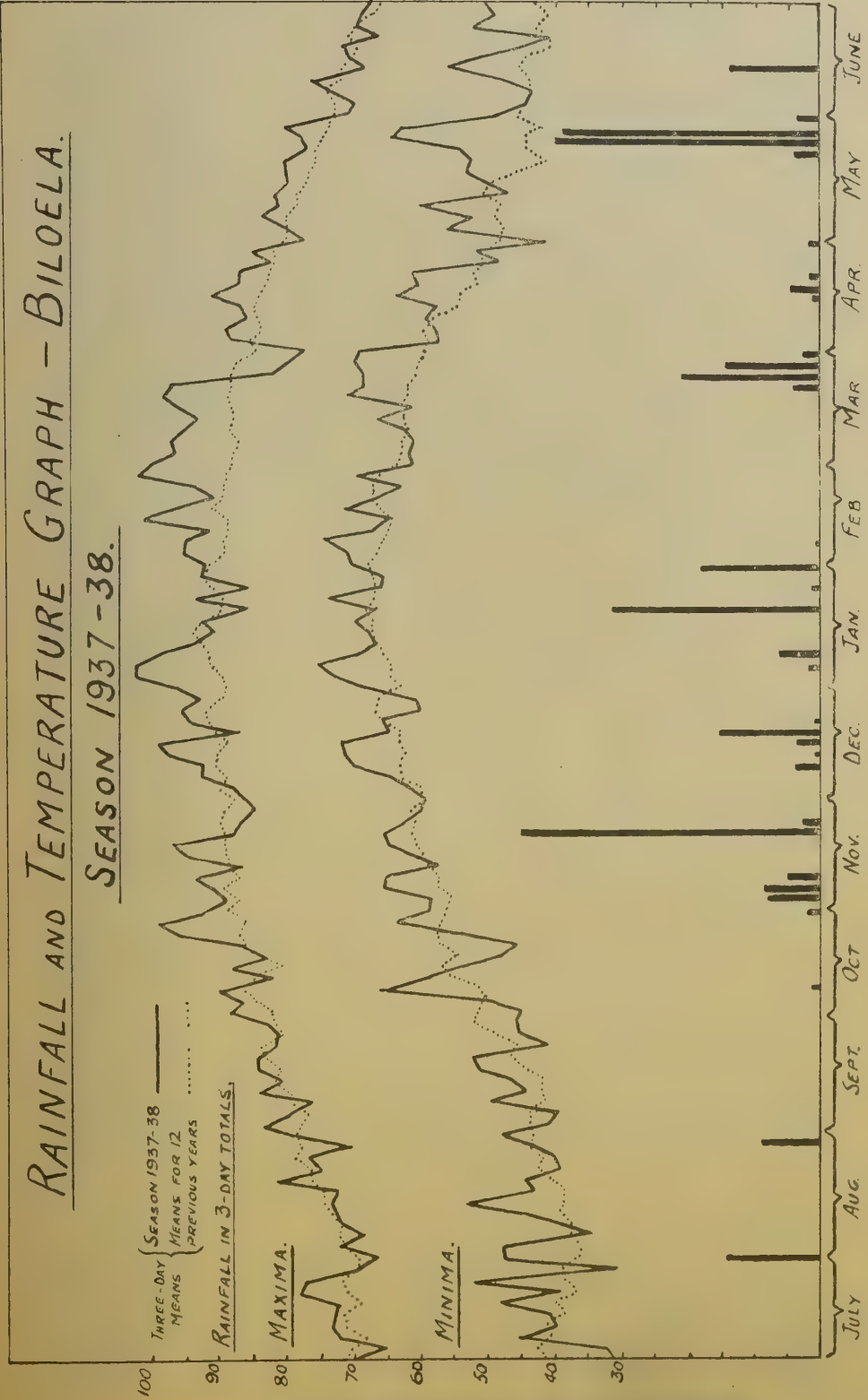
RAINFALL IN 3-DAY TOTALS.

MAXIMA.

MINIMA.

TEMPERATURE ON FAHRENHEIT SCALE.

POINTS OF RAIN.



spinners and manufacturers also like Miller cotton on account of its regularity of strength and the small amount of "spot" contained in the bulk of the lint of this variety.

The amount of damage caused by jassid attacks in most of the main cotton-growing districts of the State has become of increasing importance in recent years. Accordingly a programme of hybridization aiming at evolving a suitable jassid-resistant variety, was started at the Research Station during the season. Crosses were made between Miller, which is a big balled variety suited to the general district and also yields about the best in the most jassid-affected areas, and a U.4 strain introduced from Barberton some years ago. Tests of this U.4 strain have shown it to be capable of yielding satisfactorily under moderately heavy jassid conditions, but the small boll and weak lint, as compared with the varieties of American Upland cotton grown in Queensland, make it unsuitable for commercial growth here. A plant breeder has been especially appointed to the Research Station to concentrate on this problem on an extensive basis during the coming season. It is believed that if only moderate jassid resistance could be imparted to any of the leading varieties now grown in the State, a marked expansion in cotton acreage would result on certain soil types where jassids nearly always cause a serious reduction in yields at present.

EXPERIMENTS.

Grassland Rotational and Spacing Test.—This experiment was carried out on the same site as that of last season, to compare spacings of unthinned, 1 ft. and 2 ft. single plants on land where cotton has been grown continuously, and where cotton followed cotton following three seasons of growth of Rhodes grass.

All plots of this experiment were ploughed on July 26th, with the areas previously under Rhodes grass breaking up into a more friable condition. A fall of 1.66 inches occurred the next day, so that nitrate and moisture values received an impetus.

The mean monthly readings for the fortnightly moisture and nitrate determinations for the four months ending October are presented in Table I to afford an idea of the benefit obtained in the second season following the breaking-up of the Rhodes grass stubble.

TABLE I.
(Means for 6" and 12" levels).

Month.	Moisture %.		Nitrate p.p.m.	
	Following Rhodes Grass.	Following Cotton.	Following Rhodes Grass.	Following Cotton.
July	13.05	11.15	0.25	6.1
August	16.33	15.63	1.90	7.8
September	15.25	14.35	4.03	9.6
October	12.05	11.53	5.10	10.5

The surface of the soil of the two treatments after heavy rain showed up in very marked contrast to each other. Cotton-cotton areas were flat and smooth and lightly guttered, showing a tendency for the surface soil to run off, whereas the areas previously under Rhodes grass remained granular and nicely textured and much more conducive to moisture penetration. Plant populations proved to be better in the latter plots, which was probably due to the better moisture and more open soil, whereas in the cotton-cotton plots some seedlings had difficulty in penetrating the harder surface.

During December a marked difference in colouration began to show, plants on cotton-cotton areas developing a darker green tinge and a more vegetative habit, the direct result of an increase in nitrates to 16.4 p.p.m. in the cotton-cotton plots as compared with 4.9 p.p.m. in the plots in the second season following Rhodes grass, there being good moisture conditions in both treatments. The nitrate content of both the 1st and 2nd six inches of soil in the second year following Rhodes grass was consistently less than that of the same levels in the companionate plots until the end of June. The maximum mean reached in the former plots was 9 p.p.m. in the 1st level and 7 p.p.m. in the second level, as compared to 20 and 18 p.p.m. respectively in the cotton-cotton plots.

An examination of the soil profile at mid-December showed that although a total of 5.49 inches of rain had been received in November in seven storms, the moisture had only penetrated through the dry soil to a depth of 17 inches in the cotton-cotton areas as compared with at least three feet in the plots that had grown Rhodes grass two seasons previously. The partial network of grass roots that was still visible in the subsoil and the more open surface soil indicated the probable explanation of the better penetration of moisture to the lower depths.

The unthinned plots first showed water stress during January, followed by the 1 ft. single and finally the 2 ft. single spacings, and in all cases the cotton following cotton plots exhibited this to a greater degree than did the companionate plots. As the drought conditions continued into March, the difference between the moisture percentage of the two treatments became more marked.

The final yields show the effect of the adverse seasonal conditions. The mean of all spacings on the plots previously growing Rhodes grass outyielded the mean of the cotton-cotton plots by 52 lbs. per acre, as shown in Table II—a gain of 109.8%. A higher lint percentage was also obtained in the cotton from the areas that had had Rhodes grass.

TABLE II.
YIELD OF SEED COTTON PER ACRE.

<i>Treatment.</i>	<i>Following Rhodes Grass.</i>	<i>Following Cotton.</i>
2 ft.	121.7 lbs. per acre	60.7 lbs. per acre
1 ft.	95.8 " " "	52.5 " " "
Unthinned	96.7 " " "	45.0 " " "
Mean	104.7 lbs. per acre	52.7 lbs. per acre

Combined Fertiliser and Grassland Effect Experiment.—This experiment, which was first tested last season, was repeated on the same areas as last year. In this experiment a complete fertiliser, consisting of 3 cwt. per acre of a 4—11.5—5 formula was used to test the possibility of three years' growth of Rhodes grass having reduced the nutrients, in a soil of only moderate fertility, below the requirements of a profitable cotton crop. The experiment consisted of 6 half-acre blocks, in three of which cotton was in its second year after three years of Rhodes grass, as against three plots of continuous cotton cultivation for five years, which had been preceded by five years of various cropping.

The adverse seasonal conditions severely checked plant growth on the droughty soil of the site of the experiment. Fertilising did not affect the height of the plants on the second year after Rhodes grass plots, but on the old cotton land tended to make shorter plants than in the unfertilised plots. Both treatments on the plots in the second year following Rhodes grass were slightly taller than those of the companionate plots.

Fertilising gave a slight increase in flower production over non-fertilising in the second year after Rhodes grass plots, but definitely reduced flowering on the old cotton land, as the season progressed. Similar results were obtained in the previous season when the merits of cotton in the first season following Rhodes grass were tested. Apparently the more vegetative type of plant produced with fertiliser under dry mid-seasonal conditions requires more moisture than do the non-fertilised plants.

Yields were all low, so that they may not be indicative of the relative merits of the treatment under more normal conditions. There was no difference between the total yield of the plots in the second year after Rhodes grass and those of the old cotton land. In the former the actual yields obtained in the unfertilised were ahead, while in the latter the yields were almost exactly reversed. No statistically significant differences were obtained.

Rotations.—The usual programme of crop rotations as outlined in previous reports was again carried out. No visible difference was noticed between any of the cotton borders. The yields were most

erratic and too low to allow of any significance being attached to them. Marginal effect was most pronounced, fully 90 per cent. of the total plot yields being obtained from the guard rows and end plants.

The Rhodes grass *versus* cotton-cotton rotation laid down last season was tested again. The effect of the February–March heat wave was to stunt the plants severely and to cause shedding of all squares and young bolls.

Comparing plots following one year growth of Rhodes grass with those following cotton, the latter yielded at the rate of 82.5 lbs. per acre, while the plots following Rhodes grass gave a return of 112 lbs. per acre—a gain of 35.7 per cent.

More striking results showing the benefit of longer established Rhodes grass were obtained in another portion of the Station where the first cultivation after five years' growth of Rhodes grass yielded a mean of 261 lbs. seed cotton per acre as compared with a mean of 175 lbs. in the second year of cultivation after four years' growth of Rhodes grass, giving a gain of 49 per cent. in favour of the first year cultivation.

Oats-Maize-Cotton Rotation.—This experiment was planted on November 5th, fairly good strikes being obtained. Heavy shedding occurred during the heat wave, however, and very small yields of cotton of equal value were produced.

Fortnightly moisture and nitrate sampling was conducted in order to show the possible effect of growing a crop of oats followed by one of maize, as against a plot continuously under cotton. A remarkable lowering of nitrates by the two grass crops resulted, fortnightly readings varying between nil and 8 p.p.m., compared with a range of between 8 and 30 p.p.m. for the cotton-cotton areas.

As regards the effect of these two cropping systems on the soil moisture content, it was shown that the moisture accumulated during the summer fallow was lowered by the oats within three months to the same values in the first 18 inches of soil as ruled in the cotton plot. Following the early summer ploughing preparatory to the maize planting, the moisture content increased and remained steadily higher after the maize was planted than it did in the land on which cotton had been planted, except during February, when the maize plants, being more “surface rooters” than are cotton plants, utilised the moisture in the upper foot of soil to a greater extent. The maize crop died in March during the hot dry conditions, so that from then on the values were not indicative of the two crops.

Varietal Tests on Different Ages of Cultivation.—This experiment, comprising five varieties, was again carried out on six-, nine-, and

thirteen-year-old cultivations, and for three of the varieties on three-year-old cultivation as well. During the hot dry weather experienced soon after germination, some burning off occurred, resulting in a rather patchy stand. Terminal loss was smallest in the older cultivations, owing possibly to the tougher, more resistant plant produced.

Flower counting showed that the crop in the 3-year-old cultivation produced many more flowers than did any of the others. The flowering on the other three cultivations was rather confusing, the 13-year being a little ahead of the 6-year, with the 9-year appreciably the lowest. The crops on both the 6- and 9-year-old country were relatively slow in starting, and remained so throughout, although that on the older of the two gave higher yields of the three varieties common to all ages of cultivations. The crop on the oldest cultivation reached its flowering peak by the 5th February, after which its rate of production declined, whereas on the 9- and 6-year ages of cultivation the crops reached their peak a week later and that of the 3-year-old cultivation a week later still. It seems possible that the greater amount of nitrates in the older cultivations resulted in a quicker plant development and, therefore, the flowering was speeded up when the moisture shortage was first felt, but was quickly checked when the situation became acute. In the newer cultivation the development was more gradual, but the flowering period lasted longer on account of the better moisture content in the lower soil.

Growth was nearly normal during December and January, with the exception that the newest cultivation produced the shortest plant, partly owing to later germination, but probably also to a reduction in nitrate content due to leaching through the more porous surface soil. As the season progressed, however, the rate of growth varied, the oldest cultivation exhibiting in the later stages a definitely greener and more vegetative plant, which was accompanied by severe shedding of squares. As the effect of the February-March heat wave became evident, it was noticeable that the cotton on the newest area was the last to commence shedding and had the greatest number of bolls remaining by the end of the heat period.

Structure and boll counts demonstrated that the oldest cultivation produced a definitely earlier crop (4.6 bolls per plot as against 1.1 for the six-year-old cultivation, and 3.0 for the three-year-old) and also that the deeper tap root had enabled the crop on this old land to withstand to a certain degree the severe dry conditions. Total yields were not large, but were in the order in which the plant observations indicated, the new country yielding best. A summary of the yields of each variety is given in Table III.

TABLE III.
YIELD IN LBS. SEED COTTON PER ACRE.

Variety.	J. 7-8 13-year-old cultivation.	J. 11-12 9-year-old cultivation.	J. 13-14 6-year-old cultivation.	J. 16 3-year-old cultivation.
Durango	132	84	95	not grown
Starvale	228	126	177	
(1) Miller	187	(1) 177	(1) 149	(1) 228½
(1) Indio Acala ...	196	(1) 95	(1) 142	(1) 205½
(1) Mebane	183½	(1) 118	(1) 123	(1) 210
Mean of 5	185.3	120	137	—
Mean of (1)	188.6	130	138	215

Except on the 9-year-old cultivation plots, no significant differences were obtained between varieties. In this one case Miller was significantly greater than all except Starvale, while no significant differences existed between any of the other varieties.

Plant Spacing Test.—This is a continuation of a spacing test carried out for three seasons in the Indio Acala variety, with the Miller variety substituted this season on account of the increasing importance of the latter variety. The spacings used were unthinned, 1 ft. bunches, 2 ft. bunches, 2 ft. doubles, 1 ft. singles and 2 ft. singles.

Good moisture conditions were available at the time of planting, and a good average strike was obtained, giving a mean of 2.4 plants per foot.

Terminal loss in early January assumed a fairly high proportion—13.4%.

The effect of dry weather was soon noticed in this plot, the closer spacings suffering first and most severely. This fact is clearly demonstrated in the flower count figures. Flowering in the unthinned plots was ahead for a while, but was quickly reduced upon the advent of dry weather, whereas the wider spacings, the two foot and one foot singles in particular, continued to produce more flowers per plant. These results correspond to the results of previous years, and indicate that where moisture is likely to be a limiting factor at critical periods, it is advisable to thin out the plants sufficiently to allow them to withstand adverse conditions.

Yields were very low as a consequence of the season, the plants failing to respond to the March rains. The yields for each spacing are given in Table IV.

TABLE IV.

Unthinned	144 lbs. seed cotton per acre
1 ft. bunches	142 " " " "
2 ft. " " " " " "	143 " " " "
2 ft. doubles	187 " " " "
1 ft. singles	194 " " " "
2 ft. " " " " " "	170 " " " "

The plot was laid down as a 6 × 6 randomised block test, but no significant results were obtained. The 1 ft. single spacing yielded

the highest actual data, however, as was also the tendency in the trials with Indio Acala in the three previous experiments.

ENTOMOLOGICAL NOTES.

The pest position in the Callide Valley presented few abnormal features, any losses being overshadowed by drought effects in mid-season which caused boll and square shedding regardless of insect infestation. Early season developments presaged considerable insect activity; planting was comparatively late and corn ear worm (*Heliothis obsoleta* F.) activity would unquestionably have caused noticeable damage to middle and top crops. The normal rhythm of seasonal pest activity was, however, disturbed by dry weather which brought insect populations down to innocuous levels at a period when they are normally very high. Perhaps the most interesting feature of the year was the activity of the rough boll worm, pink boll worm and various stainers in late autumn, a sequel to unusually mild and wet weather at that time. The early removal of the crop and destruction of the field residues as a method of prolonging the cotton-free period was hampered by economic circumstances, growers being tempted by an apparently good top crop to defer eradication. For the most part, however, boll frequenting insects took heavy toll of this top crop and returns seldom warranted the delay to field operations for the 1938-39 season.

Research work on cotton pests comprised further tests with insecticidal dusts for the control of corn ear worm and various leaf-eating species, e.g., *Antarchaea chionosticta* Turn. and *Bucculatrix gossypii* Turn. The latter pests are easily controlled by arsenical dusts and field applications of a 1:1:12 lead arsenate-molasses swabbing mixture. The economic utility of arsenical dusts for the control of corn ear worm is still in doubt, but there is some evidence that a 1:1:6 swabbing mixture may be more certain in its action and reasonably cheap in practice. Striking yield data on the value of treatments were not obtained owing to the suppression of pest activity by dry weather.

Maize trap crops, swabbed with either a 1:1:1 or a 1:1:3 lead-arsenate-molasses mixture also failed to produce noticeable effects on cotton yields for the same reason. The difficult growing conditions laid emphasis, however, on the importance of correctly timing maize plantings if corn ear worm infestation in the cotton is to be materially reduced. Planting schedules for the maize have been modified in the coming season's experimental programme to ensure the coincidence of maximum moth attraction to the maize when egg-laying is taking place in the district.

SOUTH AFRICA

COTTON EXPERIMENT STATION, BARBERTON.

PROGRESS REPORT FOR THE SEASON 1937-38.

COTTON-BREEDING AND FIELD EXPERIMENTS.

BY

D. MACDONALD AND W. L. FIELDING.

Season and General.—The season finished up with a rainfall of 28·94 inches, being 4·54 inches more than the average of the previous 12 years. Excluding the season 1936–37, when the rainfall was 40·59 inches, this season's rainfall was the highest recorded since the present Station land was taken over. Unfortunately, it has again to be recorded that the distribution was extremely bad. Over an inch of rain on September 19th facilitated the preparation of seed beds, but conditions during the next two months were very dry and hot. All cotton trials, except three, were planted during 24th–27th November, following a rain of 1·69 inches on 22nd November, the last three trials being planted on 2nd December. December was very wet, and from then until mid-February good moisture conditions prevailed and a large potential crop was set before the drought that followed made itself felt. From mid-February until early April was a period of very high temperatures accompanied by little effective rainfall. During the latter half of this period the strain on the plant, which was carrying a heavy crop, was so severe that it had not sufficient vigour left to benefit by the heavy rains which fell in April.

Alternaria disease made its appearance towards the end of March, and its rapid spread was facilitated by the moist conditions in early April and the low powers of resistance of the plants due to drought. It caused a considerable loss of crop on parts of the loam soil where the plants were not well developed, but on other parts, where development was good, there was no appreciable effect. None of the cotton on the granite soil showed any effect of the disease and it finished up with very good yields. This is probably due to the fact that the crop on the granite soil was able to take advantage of the light showers during the dry period referred to above, and was in much better shape to benefit by the April rains. Selection work for resistance to the disease will be dealt with later in the report, but, as it is obvious that resistance is intimately bound up with the health of the plant, an attempt is being made to improve the health of the plant and minimise the effect of the disease by giving all cotton lands a regular dressing of compost to improve their general condition.

Similar climatic conditions to those experienced on the Station were general throughout the Barberton area, but despite adverse conditions, cotton on the light granite soils returned a profit. The value of the fact that some profit was made on the crop is enhanced when the very low price realised for the lint is taken into consideration. To compensate for a badly distributed rainfall, insect pest damage was very light. Bollworm and stainer caused little damage and, were it not for a high infestation of *D. fasciatus* on the Station, from broods bred up on stand-over cotton on a nearby farm, the damage would have been negligible. From counts made throughout the season jassid infestation was higher than in the previous year, but again, it only affected susceptible strains like Bancroft and some crosses received from Trinidad. For the second season in succession no damage was caused by aphis, and it is hoped that by controlling the species of black ant, mentioned in previous reports, damage by aphis may be reduced to a minimum.

Selections.—The bulk of the U.4 selections under trial this season consisted of re-selections from early maturing, good fruiting and high ginning families which, over a number of diverse seasons, had proved themselves able to stand up to poor conditions and produce a profitable crop. In addition, selections from certain other early families were grown, such as 998 which has done well in the Magut area as well as in certain districts of Tanganyika. Of the late maturing strains selections from the 920 and 921 families were grown, as they are lots which have done well in short dry seasons as well as in the long wet season of 1936–37.

Particular attention is being given to 052 families, and a good deal of material is being carried forward from its two derivatives 5143 and 5149, mentioned in the 1936–37 Report as having done well. The behaviour of the two strains this season is discussed under Variety Trials, where it will be seen that a re-selection 6128, made from 5143, has shown itself to be very drought-resistant and little affected by *Alternaria*. Further re-selections have been made from the 5143 family with a view to getting increased drought resistance, and possibly immunity to *Alternaria*, without impairing other desirable characters. It is hoped, by a further study of these strains, to find out if there is such a thing as specific resistance to *Alternaria*.

Twelve (U.4×Cambodia)×U.4 strains were carried on from last season in the breeding block, as well as being included in variety trials on both granite and loam soils. Of the twelve lots, ten fruited well and a number of them appeared to be more generally resistant to *Alternaria* than some of the U.4 lots. Their main defect is the poor quality of the lint, which is short and weak when compared with U.4 lint. A number of crosses have been made this season between good

Cambodia plants and our best U.4 strains, which, when back crossed, should eventually give much better material. The fact that the general resistance of $(\text{Cambodia} \times \text{U.4}) \times \text{U.4}$ to *Alternaria* is good, makes it more desirable that a large amount of crossing should be done in future to follow up this line of resistance, as well as straightforward selection for resistance in U.4.

In all the crossing carried out on the Station the method devised by Doak* has been used successfully. Experiments to find out the best time to carry out hybridization under local conditions have shown that emasculation of the bud in the afternoon previous to opening and immediate pollination give the best results.

Three back-crosses of *Gossypium trilobum* $\times$ Sea Island cotton were received from Trinidad, which were reported to be resistant to bollworm damage under Trinidad conditions. These were grown in small lots and examined regularly for American and red bollworm eggs. American bollworm eggs were laid on these crosses but, as the incidence of bollworm was very light throughout the Station, the damage was negligible. Much greater damage was done to the crosses by their susceptibility to jassid. Counts of jassid nymphs throughout the season showed about double the number of nymphs per leaf that were recorded on Rustenburg Bancroft, the susceptible type used on the Station as control. The plants grew well, but set very few bolls and these opened very badly. Their lint was very weak and harsh with a mean lint length of under one inch, as compared with the mean maximum length of about two inches when grown in Trinidad. A further trial will be given to them during the coming season, although it is felt that they do not offer much prospect of being resistant to bollworm under local conditions, except that they will be less attractive to bollworm moths than our heavy fruiting U.4 lots.

Jassid Trials.—Jassid trials of both U.4 and $(\text{U.4} \times \text{Cambodia}) \times \text{U.4}$ strains, using Rustenburg Bancroft, a susceptible strain, in order to breed up jassid, were carried out under the lay-out described in the 1936–37 Report. Jassid counts were started on February 2nd and continued at fortnightly intervals until mid-April, the actual counts being done on five leaves per plant on a 5 per cent. sample of the total plant population. In the trial of U.4 strains the average number of nymphs varied from 0.11 nymphs per leaf, on February 2nd, to a maximum of 0.25 on March 28th, a rapid decline taking place after this. On the same dates the numbers of nymphs per leaf on the susceptible Bancroft strain were:—2nd February .06, 28th March

* C. C. Doak—"A New Technique in Cotton Hybridizing," *The Journal of Heredity*, Vol. XXV, 1934, p. 201.

2-53. Little trace of jassid damage was evident on the leaves of any of the U.4 lots, while practically every Bancroft plant showed signs of severe damage. Similar results were obtained on the trial of (U.4×Cambodia)×U.4 lots along with Bancroft and three U.4 strains for comparison. Infestation in this trial was slightly more severe, but the number of nymphs per leaf was the same, both for the three U.4 lots and the crosses, while Bancroft, at the peak of infestation, gave a figure of 3·7 nymphs per leaf.

From the above results it would appear that the resistance to jassid attack of the (U.4×Cambodia)×U.4 strains that now survive is very similar to that of the best U.4 selections.

Variety Trials.—Good early stands were obtained in all trials on both loam and granite soils, except in two early planted trials, which were damaged by a sand storm. Growth and fruiting were very good, but the February–March drought prevented the maturation of all but a small percentage of the bolls set after the middle of March. The best yield from U.4 strains in the main trials on the loam was from 5143, which yielded at the rate of 239 lbs. lint per acre, while the next best was from its sister strain, 5149, giving 215 lbs. lint per acre. In one subsidiary trial, for which flowering curves are given later, 5143 and two of its derivatives, 6128 and 6130, were approximately equal, all three being significantly higher than 5149. Much higher yields were obtained on the granite, owing, as has been remarked above, to the crop on the light soil being able to utilise light showers to better advantage, and to its consequent freedom from *Alternaria*. Again the two best yielding strains in the U.4 family were 5143 and 5149, which produced 392 and 362 lbs. lint per acre respectively.

A summary of the results obtained from trials of the above two strains and 052, the strain in general cultivation, during the past two seasons in Barberton, Swaziland and Magut, is given below in Table 1. In all cases the yield of 5143 and 5149 in lint per acre is shown as a percentage of 052.

TABLE I.
RELATIVE YIELDS OF 052 AND TWO OF ITS DERIVATIVES.

<i>Year.</i>	<i>Locality.</i>	<i>Trial.</i>	052	5143	5149
1936–37 	Barberton ...	Loam 	100	127	125
1937–38 	Barberton ...	Loam I 	100	120	108
1937–38 	” 	” IV 	100	129	108
1937–38 	” 	” Jassid 	100	126	105
1937–38 	” 	Granite I 	100	123	112
1937–38 	” 	” II 	100	120	106
1937–38 	” 	Mean of 5 Trials ...	100	123·6	107·8
1937–38 	Swaziland ...	Mean of 4 Trials ...	100	112·5	106·2
1937–38 	Magut ...	Mean of 3 Trials ...	100	102·0	105·3

The results at Barberton show that both strains are definitely superior to their parent 052, though 5149 shows a smaller increase in the present dry season than it did in the previous, 1936-37, wet season. On the other hand, 5143 has given excellent results consistently in both seasons and all trials, in no case giving less than a 20 per cent. increase over 052. Reference is made later to the drought-resistance of 5143, a character that has undoubtedly helped it to maintain its superiority in the season under review.

In Swaziland the results have been generally similar to those at Barberton, with smaller differences between the three strains, whereas at Magut the differences have been negligible. In both these areas the drought was less severely felt than it was at Barberton.

Reference was made in the 1936-37 Report to the higher ginning percentage of 5143 and 5149 compared with 052. This increase was confirmed during this season at Barberton, Bremersdorp and Magut, as shown in Table II.

TABLE II.
ANALYSIS OF SEED COTTON OF 052 AND TWO OF ITS DERIVATIVES.

<i>Locality.</i>	<i>Strain.</i>	<i>Ginning %</i>	<i>Wt. of 100 seeds (gms.)</i>
Barberton.	052	35.0	8.9
Mean of 5 Variety	5143	35.8	9.8
Trials.	5149	36.9	9.4
Swaziland.	052	34.6	10.0
Mean of 3 Variety	5143	36.4	10.1
Trials.	5149	37.8	10.1
Magut.	052	34.1	10.5
Mean of 3 Variety	5143	35.0	10.6
Trials.	5149	36.2	10.1

Both 5143 and 5149 were multiplied by two farmers in the Barberton district this season and did very well. 5149 was grown on old tobacco land and was so badly droughted that a fair comparison between its lint and that of 052 was not possible. A sample of 5143 lint, along with a sample of 052 lint grown on the same farm, was sent to the Government Cotton Grader for a report on their quality, and he reported that the lint of 5143 was of a much better quality than 052. This is all the more noteworthy when it is considered that the 5143 strain was multiplied on very poor land as compared with the land on which the 052 was grown.

Earlier in this report it was mentioned that in one subsidiary trial the strain 5143 was equalled by two of its derivatives, 6128 and 6130. Sufficient seed is now available to include these two new strains in a range of trials next season.

Flowering curves of eight of the strains included in this subsidiary trial are given in Fig. 1. It will be seen that the 045 strains, which are quite good in an ordinary season, fell off in flowering at an early

stage as conditions became drier, whilst the 052 family carried on as a group much further. Again, of the 052 group, 052 itself and 5149 were the next to fall away, leaving the sub-family 5143, and its two derivatives, 6128 and 6130, to carry on strongly right through the extremely dry period. The toughness of the 5143 group was easily seen in the field, and the healthy appearance and leaf-holding capacity of 6128 was particularly striking since it retained a healthy leaf right through the drought and the *Alternaria* attack which followed.

An account of similar indications of drought-resistance was given in the 1934-35 Report, pages 14 and 15. In that case 052 showed up very well in comparison with the strains then under trial. The advance made in its later derivatives, the 5143 group, as demonstrated this season, is all the more noteworthy.

The yields of lint in lbs. per acre of the above strains, expressed as percentages of 052, were:—6128=130; 5143=129; 6130=128; 5149=108; 045 (mean of three derivatives)=76; the first three strains being significantly higher than all others.

The (U.4×Cambodia)×U.4 strains at the end of last season were reduced to twelve in number. These were included in a variety trial on both granite and loam soils, along with three U.4 lots as control. The trial on the loam soil was on a field of rather poor fertility, while drought and a certain amount of white ant damage to the stand made the results unreliable. On the granite soil, however, the trial gave excellent results, the final yield figures ranging from 444 lbs. lint per acre from strain H.19 to 284 lbs. lint per acre from H.1. Although H.19 finished up with the highest yield, it was not significantly better than the best U.4 strain 5149. (Unfortunately, 5143 was not included in this trial.) A comparison of the lint analysis, as an average of the three main pickings for these two strains, is given below.

Strain.				Ginning %	Seed Weight (gms.)	Lint Length (mm.)
H.19	...	...	...	36.3	8.1	28.9
5149	...	...	...	37.9	9.2	30.8

The four best lots from the above crosses have been sent to Swaziland and Magut for testing in variety trials along with good U.4 lots next season.

Investigation of Sampling for Lint Length in Variety Trials and Single Plant Selections.—With a view to determining the accuracy of the estimation of differences in lint length between strains, an investigation of sampling technique was carried out on the main variety trial on the granite soil. Individual plot samples of the nine strains were taken at random during picking, immediately prior to weighing.

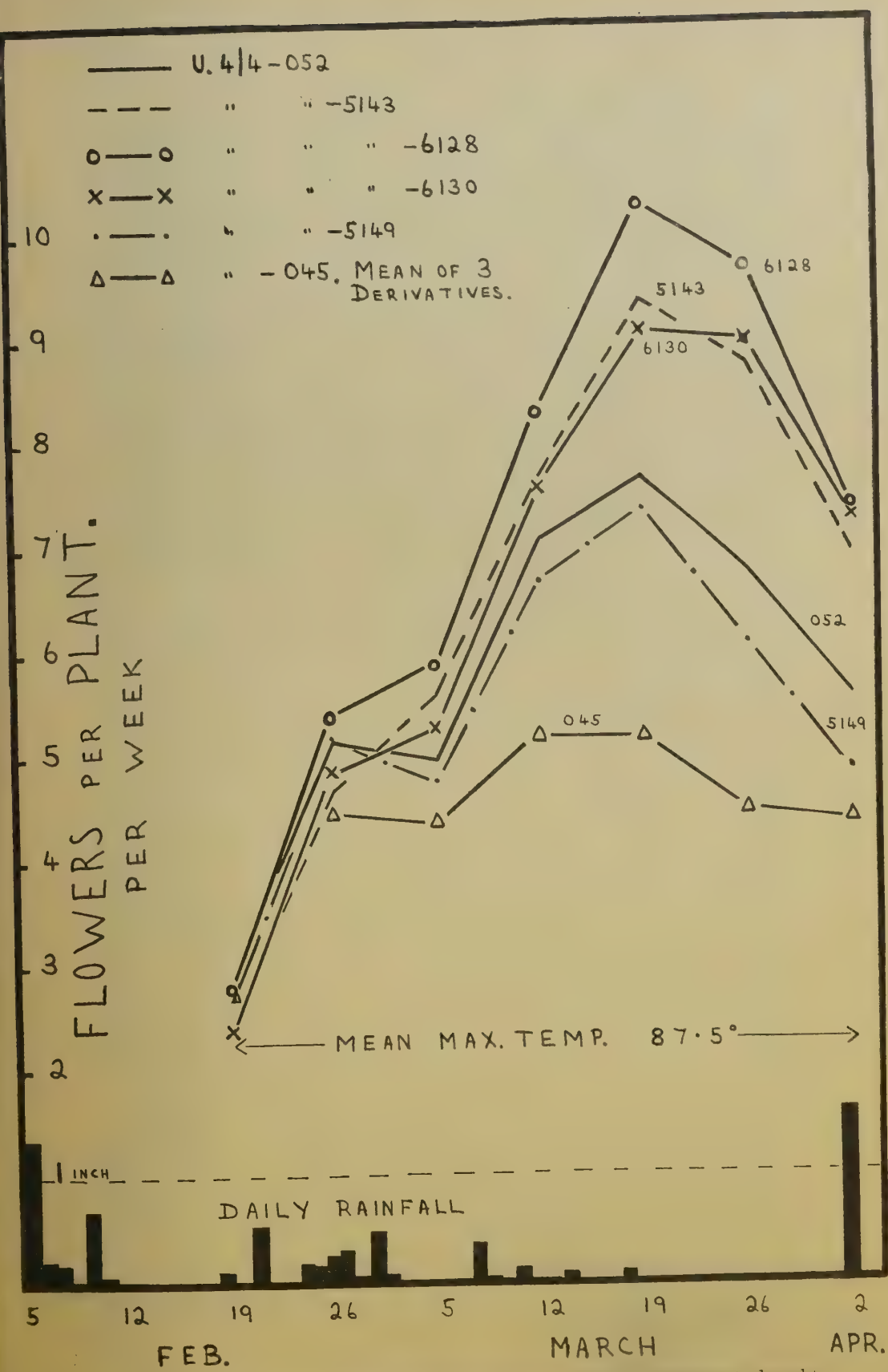


FIG. 1. Flowering curves indicating differences between strains in resistance to drought.

From these small samples 30 seeds per plot were taken at random and combed by trained natives. Five combers were used, each combing two complete blocks, so that provision was made for elimination of personal error. This provision also applied to the laying out of seeds for measurement, each "layer-out" doing a complete block.

Ten replications were available, and the investigation involved the measurement of 2,700 seeds. Each seed was measured by the junior author of this report, and by two European lay assistants. From the data available it is possible to compute the range of sampling efficiencies with samples of 1 up to 30 seeds per plot, and also to judge the efficiencies of the three individuals who actually measured the lint. It is further possible to compute the effect of including a smaller or larger number of replications in the calculations.

Considerable progress has been made in analysing the data. Including all ten available replications, the analysis reveals the accurate estimation of differences of 1.33 mm. with samples of three seeds per plot, and, following in direct sequence, an increase of accuracy with increase in number of seeds, the 30-seed samples making possible the estimation of a difference of 0.66 mm. However, the very convenient sample of 5 seeds per plot gives accurate estimation of a 1.03 mm. difference, which should be satisfactory in most cases. Increase in number of replications appears to be more important than increase in the number of seeds per sample, and the advisability of taking plot samples where possible, as opposed to bulk strain samples, is demonstrated. The examination also included material from single-plant selections, but the data have not been fully analysed at the time of writing. On completion of further analyses the work will be prepared for publication, together with work on sampling for ginning percentage, and a description of the actual method of lint measurement in use at Barberton.

Fertilizer Trial.—The results obtained on the value of dressings of Nitrate of Soda to the cotton crop on the light granite soil of the Station in past seasons were confirmed on a farm in the Barberton district this season. A randomized block experiment, comparing a dressing of 200 lbs. per acre Nitrate of Soda with no fertilizer, on cotton, was laid down on land kindly offered by Mr. Arkell. The Nitrate was applied as a top dressing at thinning time, and cultivated in immediately. The final yield figures, given below, show a substantial increase from the Nitrate dressing.

200 lbs. Nitrate of Soda	1,106	lbs. seed cotton per acre						
Nil	...	...	...	798	"	"	"	"
Difference for $P=0.05$	...	46.7	"	"	"	"	"	"

The increase of yield of lint resulting from this application represented an additional profit of over 16/- per acre from the use of the fertilizer.

Varying number of seeds per hill.—This experiment, referred to in last year's report, was repeated during the season, but the experimental design was modified. Plot-shape was altered to conform with the findings of work on uniformity trials carried out at Barberton. Two-row plots, 189' long, were used, the spacing being 3' both between rows and within the row. In order to make possible a study of the combined effect of number of seeds per hill and time-of-thinning on ultimate yield, the number of treatments was increased to twelve. These were 2, 3, 6 and 10 seeds per hill, with three plots of each seed-number treatment in each block, making provision for an early, medium and late thinning on a complete plot of each, instead of on sample plants only as in the previous season. It was thus possible to carry out a detailed study of general plant development for each of the twelve treatments throughout the season, from germination to final yield. Final yield figures were taken from the centre 147' of row, the remaining 42' being used for sampling after all thinnings had been carried out.

The results of the two seasons agree fairly closely, three seeds per hill with normal time of thinning, or six seeds with very early thinning, being better than either two seeds or 10 seeds per hill. The full results of the past season's work on this experiment are being prepared for publication.

Gap filling experiment.—The normal practice in cotton trials, when an initial bad stand is obtained, is to replant as soon as possible the hills in which the seed has either not germinated, or, having germinated, has been destroyed by insect or storm damage. The plants derived from the second planting are always small and appear to be dominated throughout the season by the plants which germinated from the first planting. An experiment was designed to see what effect, if any, replanting of gaps had on final yield. The results from this season's experiment were inconclusive and it is proposed to repeat the experiment during the coming season.

Analysis of crop loss.—Preliminary investigations were begun with a view to attempting to classify the various causes of crop loss from bud to boll throughout the season.

Compost Trials.—Trials were carried out on both granite and loam soils during the season, comparing cotton yields under dressings of 6 tons and 3 tons of compost per acre with Nil. Green weight samples taken on both experiments 65 days after planting, on the granite trial showed the 6-ton treatment samples to be significantly heavier than the

Nil plot samples, while, on the loam trial, samples from both the 6- and 3-ton plots were significantly heavier than samples from the Nil plots. In spite of this, final yield figures gave no significant difference, although the plots receiving 6 tons of compost per acre gave higher yields than the untreated plots. The small differences in final yield are probably accounted for by the fact that both the fields on which the trials were carried out were in good condition and gave heavy yields (for the season) on the unmanured plots. For the coming season permanent compost trials have been laid down on both granite and loam soils, on fields which, judging by past crop records, are known to be in a low state of fertility. The lay-out of the experiment is randomized blocks with plots receiving 7 tons, $3\frac{1}{2}$ tons compost, and Nil, followed by cotton. In alternate years the fields will receive a dressing of 200 lbs. superphosphate per acre, followed by maize. In this way it is hoped gradually to build up the productive capacity of these poorer lands.

In last season's report it was mentioned that several compost pits had been charged in a preliminary attempt to find out the essential constituents necessary to ensure rapid and satisfactory breaking down of waste material. The vegetable matter available for composting consisted chiefly of maize stover, with a small amount of sunflower and bean stalks. This material was fed to oxen in a kraal, the uneaten portion being partially broken up by trampling, and at the same time becoming impregnated with dung and urine of the cattle. This material, amounting to about 7,000 cu. ft., accumulated in the kraal from May to August. During this time the 36 oxen on the Station were not penned in the kraal but had free access to it to feed on the stalks whenever they wished.

The other constituents used were ash from burnt cotton stalks, ordinary soil which had been dug out of the pits, and urine earth, *i.e.*, the top layer of soil under the vegetable matter in the kraal which had absorbed any urine that had percolated through to it.

The pits were charged in layers in a manner that ensured thorough mixing of the constituents used, each layer being well watered as it was put in. The pits were filled between September 2nd and 7th, 1937, and took about $3\frac{1}{2}$ months to decompose. During this period the material in the pits was turned at approximately monthly intervals and watered at turning time, if necessary. No difference in speed of decomposition or in final appearance of the finished compost was observed between differently charged pits. The compositions of the pits, when charged, are shown in Table III, in cubic feet of the different constituents used.

TABLE III.

Pit No.	Kraal Stalks.	Ordinary Soil.	Urine Earth.	Ash.
1... ..	990	Nil	Nil	15
2... ..	990	28	28	15
3... ..	990	Nil	56	15
4... ..	990	Nil	Nil	Nil
5... ..	990	28	Nil	Nil

After decomposition was complete duplicate samples from each pit were kindly analysed for us by the Division of Chemical Services of the Department of Agriculture of the Union of South Africa, and gave the analyses shown in Table IV.

TABLE IV.
PERCENTAGES ON AIR DRY MATERIAL.

Pit No.	Total N %	Av. K_2O %	Av. P_2O_5 %
1... ..	1.132	0.746	0.230
2... ..	0.828	0.495	0.128
3... ..	0.912	0.349	0.114
4... ..	1.246	0.523	0.157
5... ..	0.837	0.275	0.077

Available K_2O and P_2O_5 represent the amounts soluble in 2 per cent. citric acid. The percentage of air-dry matter in the finished compost was about 42 per cent.

It should be noted that the addition of soil, in charging the pit, results in the presence of that soil in the finished compost. In pits 2 and 3 this would amount to upwards of 25 per cent. by weight, and in pit 5 to half that amount. The presence of this inert matter has to be taken into account in comparing the analyses: thus, in the above pits, it would account for the lower figures they have given. This would apply equally to the organic matter content of the compost.

The nature of the experiment does not allow of strict comparisons being made, but it is clear that, with material put through a kraal as described, neither soil nor ash is required either to promote rapid decomposition or to produce excellent compost. The soil merely acted as a diluent, increasing the labour of charging and turning, as well as of the subsequent carting and spreading of the compost. Ash, of course, put up the potash content of the compost, and, where it is easily available, it might be a useful addition from this point of view. Pits are essential to conserve moisture in the compost during the dry season, where the supply of water is limited, but during the rainy season compost has been made just as satisfactorily in surface heaps.

Rotation Experiment.—On the loam soil the rotation experiment, which was first laid down in 1932, was continued for a further year; the experiment on the granite soil being discontinued.

Height measurements, green weights and fruiting counts showed that cotton following sunflowers had attained the best development

by the end of March, but the final yield figures once again demonstrated the beneficial effects of a fallow. Cotton following fallow gave a yield of 720 lbs. seed cotton per acre, a significantly higher yield than cotton following any of the other rotation crops (teparty beans, soya beans, sunflowers, maize or cotton).

The experiment is to be continued for two more seasons, after which the results will be analysed in detail for the whole of the eight-year period.

COTTON EXPERIMENT STATION, BARBERTON.

1937-38.

DAILY RAINFALL.

Date.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June
1 ...	—	—	—	—	—	0.32	0.03	—	0.46	—	—	—
2 ...	—	—	—	—	—	—	—	—	0.04	1.61	—	—
3 ...	—	—	—	—	—	—	—	—	—	0.11	—	—
4 ...	—	0.02	—	—	—	0.05	—	—	—	0.79	—	—
5 ...	0.02	—	—	0.15	0.14	0.25	0.03	—	—	—	—	—
6 ...	—	—	—	0.07	0.62	0.12	—	1.36	—	0.51	—	—
7 ...	—	—	—	0.22	—	1.14	—	0.19	—	—	—	—
8 ...	—	—	—	—	—	—	0.07	0.17	0.34	—	—	—
9 ...	—	—	—	—	—	—	0.16	—	0.01	—	—	—
10 ...	—	—	—	—	—	0.16	—	0.67	—	—	—	—
11 ...	—	—	—	—	—	—	—	0.03	0.09	—	—	—
12 ...	—	—	—	—	—	—	0.47	—	—	—	—	0.13
13 ...	—	—	—	—	—	0.04	—	—	—	—	—	—
14 ...	—	—	—	—	—	—	—	—	0.04	0.04	—	0.51
15 ...	—	—	—	—	—	0.01	0.02	—	—	—	—	0.03
16 ...	—	—	—	—	—	0.21	0.02	—	—	—	—	—
17 ...	—	—	—	—	—	—	—	—	—	1.10	—	—
18 ...	—	—	0.31	—	—	—	—	—	0.05	—	—	—
19 ...	—	—	1.10	—	—	0.68	—	0.07	—	—	—	0.02
20 ...	—	—	—	0.05	0.03	2.29	—	—	—	—	—	0.84
21 ...	—	—	—	—	0.32	—	—	0.54	—	0.15	—	—
22 ...	—	—	—	—	1.69	0.08	0.43	—	—	1.36	—	—
23 ...	—	—	—	—	—	0.22	0.21	—	—	0.13	—	—
24 ...	—	—	—	—	0.41	1.48	0.02	0.14	—	—	—	—
25 ...	—	—	—	—	0.02	0.05	0.35	0.13	—	—	—	—
26 ...	—	—	—	—	—	0.58	—	0.21	—	—	—	—
27 ...	—	—	—	—	—	—	—	0.29	—	—	—	—
28 ...	—	0.02	—	—	—	0.21	—	0.03	—	—	—	—
29 ...	—	0.04	—	—	—	—	1.10	—	—	—	—	—
30 ...	—	—	—	—	—	0.05	0.05	—	—	—	—	—
31 ...	—	—	—	—	—	0.62	—	—	—	—	—	—
Total ...	0.02	0.08	1.41	0.49	3.23	8.56	2.96	3.83	1.03	5.80	—	1.53

ROTATION CROPS.

BY

M. F. ROSE.

General.—The season opened favourably and excellent stands were obtained for all crops. The early promise of record yields for all plantings was, however, not realised owing to a bad drought in March, whilst unusually heavy rains in April (5·8 inches) caused much anxiety in harvesting and drying operations. The season was remarkably free from insect pests, early and late maize plantings showing very little stalk-borer and cut-worm damage respectively. Streak disease in all maize plantings came in late, but the attack on the late single-plant lots was severe enough to allow of elimination of the more susceptible lines.

Maize.—All maize variety trials were dropped from the season's programme, sufficient data having been accumulated from the past five seasons' results to give a line on the most suitable strains and spacing. Bults of Arkell's Hickory, Anveld and American White Flint, machine-planted in late November and mid-December, gave excellent yields of high quality grain. From an area of 4·4 acres, Hickory averaged 3,668 lbs. per acre. Peruvian replaced all strains for late planting (January 5th and 14th). Synthetic Anveld (bred by Dr. Saunders of Potchefstroom) was grown under observation at the Station for the first time this season: a quick maturing type (approximately 7 days earlier than ordinary Anveld), the new introduction showed great promise for early planting, but its great susceptibility to streak disease would militate against its use for mid-season and late planting (see streak count figures).

Streak Disease.—Streak disease was slow in making its appearance, even in late planted lots. Bulk plantings of the more susceptible strains, American White Flint and Anveld (planted November 29th and 30th) showed practically no infection throughout January: later plantings of January 4th, counted on February 18th, showed a mean infection figure of 28·8%. It is interesting to compare this figure with that of the previous season. The dates of planting and counting were practically identical for the two seasons, but the 1937 counts gave an infection figure of 99·9%.

Two hundred and thirteen selfed lines of Peruvian, 128 of Hickory, 15 of American White Flint and 56 of Anveld were planted on January 4th—as late as possible to ensure a reasonable attack of streak with hopes of a fair return of seed. The thirteen crosses, Peruvian (female parent) × Hickory (male) were planted on the same date. In planting the selfed lines, two progeny rows were alternated regularly with one

line of the susceptible White Flint bulk, a procedure adopted for building up an infective vector population for the bombardment of the more resistant lines.

All selfed lines of Hickory and Peruvian yielded excellent material as far as streak resistance was concerned, being far superior to their parental bulks. Fifty-two lines of Peruvian and 20 of Hickory were eventually retained. The lines of American White Flint and Anveld were, however, disappointing and streak counts showed very little advance in resistance over their respective bulks. Consequently all lines from these strains were dropped. The F_1 plants from the Peru $\times$ Hickory cross exhibited marked hybrid vigour and offered very promising material for future work. The streak count table below shows the advance made in the selfing and selection programme. Both bulks and selfed lines were planted on January 4th and counted on March 11th. Thus all figures are strictly comparable.

STREAK COUNTS.

Percentage figures of plants showing different degrees of infection.

	<i>Non Infected.</i>	<i>Light Infected.</i>	<i>Medium Infected.</i>	<i>Heavy Infected.</i>	<i>Plants Counted.</i>
Peruvian (best 52 lines) ...	99.2	0.75	0.02	—	2985
Peruvian Bulk ...	82.4	15.3	1.4	0.9	222
Hickory (best 20 lines) ...	79.6	16.0	3.0	1.4	1412
Hickory Bulk... ..	23.6	43.1	17.8	15.3	207
Synthetic Anveld Bulk ...	14.5	23.2	22.7	39.7	207
Anveld Bulk	13.7	33.6	26.7	26.0	206
A.W. Flint Bulk	12.1	37.3	23.2	27.4	207

Of the 52 best lines of Peruvian, 39 lots gave counts of 100% non-infected plants.

Counts were also made on the F_1 plants of the 13 crosses. The range of non-infected plants between lots was from 83.8%—96.0%. In no case did any lot show 100% resistance, in spite of the fact that 3 of the 13 Peruvian parents gave 100% non-infected plants in the 1937 counts.

Stored Seed Maize : Grain Moth and Weevil Control.—The control of these pests has to date been effected by the use of carbon bisulphide (3 lbs. per 1,000 cu. ft.) repeated at monthly intervals. This fumigant, besides being dangerous to handle in a confined space, is expensive and troublesome to use and endeavour was made to find some contact insecticidal dust which could be mixed with the grain at shelling and left without further anxiety. Borax, calcium hydroxide, sodium fluosilicate, flaked naphthalene and sodium fluoride were used. Of these, as far as the control of the insects was concerned, sodium fluoride at the rate of 1 : 1,000 (by weight) gave the best result. The question of impairing germinative capacity arose and an experiment was laid down to test the comparative effects of carbon bisulphide (normal)

and sodium fluoride on the seed. Full data are given below :—

Sodium fluoride (2 : 1,000—double rate) mixed with seed
29/7/37.

Carbon bisulphide ; normal treatment (3 lbs. per 1,000 cubic ft.)
monthly treatments from and including 29/7/37.

Trial planted 2/12/37.

GERMINATION %.

		1st Count 10/12/37.	2nd Count 17/12/37.	
Hickory ...	NaF	75.2	85.7	All diff. exceed 1% pt.
(flat dent) ...	CS ₂	89.4	91.8	
A.W. Flint ...	NaF	77.3	87.0	
(round flint) ...	CS ₂	92.1	93.8	

GREEN AND DRY WTS. (GMS. PER PLANT).

		Sampled 23/12.				Final Yield (Lbs. per acre : grain).
		Green wt.	Sign.	Dry wt.	Sign.	
Hickory ...	NaF	20.2	1% pt.	2.55	1% pt.	3450
	CS ₂	23.2		2.94		3464
A.W. Flint ...	NaF	14.9	1% pt.	1.98	1% pt.	2944
	CS ₂	17.5		2.36		3000

It is obvious that the sodium fluoride treatment has delayed germination and reduced the percentage of seeds germinating. Growth rate differences (in favour of carbon bisulphide) were also marked during the early stages. The final yield figures, however, are practically identical, showing no effect of early growth differences. The stands of plots taken for final yield were not affected by germination percentages owing to the planting of two seeds per hill and final thinning to one plant.

Unfortunately there was no direct comparison of seed treated with carbon bisulphide *versus* completely untreated seed, but in tray experiments, where direct comparisons were possible, carbon bisulphide had a definite stimulating action on germination. The results of this work are being prepared for publication.

Stooking and picking experiment.—The object of this experiment was discussed in the previous report. The 1936 layout, however, was totally revised owing to the inclusion of extra treatments. The reason for their inclusion and the subsequent revision of layout was as follows :—

It was desired to ascertain if the cob benefited from the stalk while still in the stook, a benefit in terms of yield, chemical composition, or both. With this object in view “pickings,” in which the cobs were removed from the plants, were taken on the same occasions as

“stookings,” at regular intervals starting at 42 days from the peak of the tasselling phase. Thus instead of the 5 treatments (4 stookings + 1 normal) of the 1936-37 experiment, 9 treatments were obtained for the 1937-38 experiment. With a larger plot error (owing to the wider scatter of more plots per block) to test a smaller mean difference (between the stooking and picking yields of the same occasion) significant differences were not expected by the old layout and a yield difference, which might be of real practical significance to the farmer, would probably be judged non-significant statistically.

Instead of having the 9 treatments randomized in separate plots over each block, each block of 16 rows was treated as a whole from which the 9 treatments were successively sampled. The sample for each treatment was 10.5% of the block, giving about 96 plants, and the new layout gave 20 replications. The results, expressed as percentages of the yield from the normal picking treatment, are shown below.

Type: Hickory. Planted 29/11/37. Free Tasselling 4/2/38.

<i>Treatment.</i>	<i>Days from peak of Tasselling.</i>	<i>Condition of grain.</i>	<i>Yield Expressed as percentage of Normal.</i>	<i>Seed wt. (gms. per 100 seeds.</i>
1st Picking ...	42	just passed milk stage	60.6	35.9
1st Stooking ...			72.1	45.7
2nd Picking ...	49	very soft cheese stage	77.2	45.7
2nd Stooking ...			87.8	56.7
3rd Picking ...	56	soft to medium—hard cheese stage	89.4	53.0
3rd Stooking ...			94.0	55.2
4th Picking ...	63	very hard cheese stage	93.5	58.5
4th Stooking ...			100.5	60.7
Normal ...	75	fully ripe	100.0	59.7
5% diff. reqd. ...			3.9	

Moisture content estimations at the time of weighing revealed no difference between seeds from stooked, picked or normal cobs: all had dried out equally by 3rd August to an average moisture content of approximately 10%.

Under the existing conditions it appears that stooking could be done without loss a fortnight before the crop would normally be judged ripe for harvesting. Picking at this stage, however, would mean a loss of just under 7%. Even at this last stage in the development of the plant, the figures show that the cob derives considerable benefit from the haulm while still in the stook. This divergence in yield between the two treatments for any one occasion becomes more marked with the immaturity of the plant, reaching a maximum of 19% (in favour of stooking) six weeks after the peak of tasselling.

Analyses of duplicate samples of grain from the 9 treatments were kindly undertaken by the School of Agriculture, Cambridge. The mean values, calculated on 100% dry matter basis, are shown below.

Sample.	% Crude Protein.	% Crude Fibre.	% Ether Extract.	% Nitrogen- free Extractives.	% Total Ash.	% Silica-free Ash.
P.1 ...	10.86	2.16	2.96	82.45	1.58	1.54
S.1 ...	9.48	2.22	3.64	83.29	1.38	1.35
P.2 ...	10.19	2.05	3.80	82.47	1.49	1.45
S.2 ...	9.65	1.89	3.06	83.87	1.55	1.49
P.3 ...	10.08	1.60	3.98	83.04	1.31	1.28
S.3 ...	9.78	1.99	4.03	82.96	1.29	1.25
P.4 ...	9.73	2.05	4.29	82.67	1.27	1.23
S.4 ...	9.71	1.91	4.47	82.62	1.31	1.27
Normal ...	9.70	1.73	4.51	82.77	1.31	1.25

The above figures reveal no very marked difference between the two treatments: note should be made, however, of the increase in fat content and decrease in silica-free ash with maturity: the nitrogen-free extractives remain fairly constant during the last five weeks of growth.

Witchweed.—Hand collections at intervals of 10 days were commenced on January 27th. Very little was removed from the lands in January, February and March and trap crops of amber cane (early December planted) failed to bring the parasite to the surface. The April collections, however, showed a big increase due probably to a fall in soil temperature: the mean maximum soil temperatures (6" level) for January, February and March were 97.0°F., 94.3°F., and 96.2°F. respectively, as compared with 84.7°F. for April. The optimum temperature for the germination of the seed is between 85–90°F.

Kaffir Corn.—The eight Kaffir corn lots (5 white and 3 red) obtained from Bremersdorp yielded well and gave promise of interesting material; under the conditions of the season, they were all reasonably free from aphid or rust. On the average the whites outyielded the reds, PR 31 (white) giving 1,727 lbs. per acre with PR 133 leading the reds with a yield of 1,284 lbs. All lots will be grown under observation next season.

Sunflowers.—There was no bulk planting of sunflowers on the Station during the season. The rotation plots (loam) planted on November 27th, gave 1,471 lbs. per acre.

Tepary and Soya Beans.—These beans, planted on December 23rd over the rotation plots, made good headway in the early stages of growth, but were badly affected by the March drought. The quality of grain and yields—965 lbs. per acre for soya and 1,311 lbs. per acre for teparies—were good considering the conditions at the time of pod-filling.

INSECT PEST WORK.

Dr. R. C. Rainey joined the staff as Insect Physiologist in February. The Report includes a note on his activities in recent months.

The Staff has also been increased by the appointment of Dr. G. M. Wickens as Mycologist.

Mr. B. L. Mitchell proceeded to Nyasaland in July to engage in work on the red bollworm. The Report contains references to his participation at Barberton in studies of the insect community in the cotton and maize crops, variability in strains of the American bollworm moth, and some anatomical and histological examinations of bollworm pupæ and moths.

INVESTIGATIONS ON THE AMERICAN BOLLWORM.

BY
F. S. PARSONS AND J. MARSHALL.

During the past year the survey of the incidence of this bollworm was confined, as indicated in the previous Report, to comprehensive examples of (1) a winter-breeding area, (2) the period of breeding on weeds and early summer (irrigated) crops, and (3) a summer breeding area (The Cotton Experiment Station). Data from these sources have proved adequate for the purposes of characterizing the scale and course of bollworm activity and for providing the various stages of material required for continuity of the records and investigations mentioned in this and earlier Reports.

For the period under review bollworm was generally inconsiderable, but there were occasions of heavier egg-laying which facilitated progress in several directions.

Cotton on the Experiment Station and elsewhere in the district was singularly free from American bollworm and, although lack of moisture interfered with crop production during March, the absence of bollworm provided to some extent a basis for comparison in attempts, now entering the third year of investigation, to assess losses in cotton attributable to this pest, especially in the light of present-day information with regard to the time relationships of the principal attack on cotton, of which some mention is made below.

An early attack of bollworm, due to moths entering summer crops from the breeding grounds in No. (2) above, materialized according to expectations, which are now based on four years' data that display remarkable similarity in the annual march of events. As the crops concerned were all planted between November 24th and November 27th no moths bred in the real winter-crop, or No. (1) breeding area, contributed to this, the initial infestation of the season (cf. page 27, Repts. from Expt. Stations, 1936-37). The attack referred to fell

very largely on maize planted coincidently with cotton: it was moderately heavy, being of the same order as that on maize in 1937. Moths arising in February from this first generation also laid mainly on maize planted, in these instances, in mid-December, the infestation being much reduced. The presence of a third, smaller flight of moths was evidenced in April by increased egg-laying on dolichos beans.

Alternative Food-Crops of the Bollworm.—Following on the information reported from Gatooma last year that a strain of *Dolichos lablab* grown there received a large preponderance of egg-laying both before and during the flowering period, seed from Gatooma and of two other strains of *Dolichos* with shorter growing and earlier flowering habits was planted at Barberton for observations on bollworm relationships. Egg-laying to a considerable degree occurred on the Gatooma strain forty days after planting, whereas flowering commenced 112 days from planting, the observation at Gatooma in this respect thus being confirmed. In our experience this is the second instance of the moth attending a crop for egg deposition long before the plants are in flower, the chick pea (*Cicer arietinum*) being the other instance.

Eggs were laid on the other two strains of *Dolichos* (one from Pusa, which resembles closely a cowpea, and the other from Ceylon via the Sudan), coincidently with flowering. It is noteworthy that a strong aromatic scent is volatilized from the strain of plants introduced from Rhodesia, even from quite young plants, whereas the associated glands and scent are absent in the other two strains.

At the peak of egg-laying an equal area of maize, then in tassel alongside the Gatooma dolichos field, was laid on two to three times more heavily per acre than the dolichos, and egg records on the latter remained comparatively low until April when cotton was the only other crop with fresh growth. During April practically all the egg-laying on the Station was concentrated on the one small field of dolichos.

On the evidence from the one season dolichos was less attractive to the moth than local maize, but it continued in an attractive state over the entire season and appears to have a low breeding propensity, as only 1.4 per cent. of the larvæ feeding in the crop matured. Attention is invited to the reference to dolichos beans in the investigations reported from Magut in a later section of this Report.

Investigations on Variability in Strains of the Bollworm Moth.—Various considerations, but particularly differences in behaviour towards food-plants as reported from other territories, suggest the existence of strain variability. Some preliminary observations on this subject have been made in an examination of moths bred from

Sudan and Rhodesian pupæ in comparison with Barberton material. The following resulted :—

Apart from such variations in size as occur in our own moth populations, no morphological differences could be discerned except that, as observed by Mr. Mitchell, there was a distinct and constant difference in the degree of pigmentation of the hind wing of moths from the original lots of pupæ. The pigmentation ranged from very light in the Sudan material to comparatively dark in the Barberton lot, with Gatooma moths intermediate. Attempts to learn if these variations persist were frustrated for the time being as there was complete mortality of the larvæ bred from the Sudan moths (comprising all our stock) when fed on maize, which happened to be the only available food. From correspondence received, maize in the Sudan is not oviposited on and the failure of these larvæ to subsist may or may not be significant.

The genitalia of the moths from the three sources were alike and instances of fertile crosses were obtained in each of the possible combinations.

Moth Flights and Factors Influencing the Pupal Stage.—In the previous Report some prominence was given to discussing materials and methods used in attempts to determine the annual course of moth flights, the important sources of breeding and the extent to which one or the other might, owing to the earliness or lateness of the summer-planting season, contribute to the initial infestation in summer crops. During the three years prior to that under review there had been no departure to any degree from the sequence of events outlined in the previous Report where, among other comments, it was stated that the existence of a regularity in calendar time of the main features of the succession of events had been established. During the past dry season, however, moths emerged extensively from the usual “over-wintering” pupæ some weeks before activity on any scale was expected.

Up to last year the dry seasons had been truly dry, whereas that of the present period was comparatively wet and soil moisture contents at pupation depth ranged from 10–19 per cent. throughout July, August and September, as compared with 3·5–5·5 per cent. recorded in the earlier years. As yet no attempt has been made to estimate the influence of temperature and soil moisture on the behaviour of pupæ that have entered long resting periods between March–April and late July onwards. Difficulties in method and criteria for recognition of the inception of the resting period (or diapause, see reference below to Mitchell's results) have delayed this endeavour.

We had determined, however, that the duration of the pupal stage during the late winter and summer months (when no diapause has been recorded) is related closely to both temperature and soil moisture content. For example, the minimum soil temperature for two weeks following pupation has a significant negative correlation with the length of pupation. Air temperature also has some effect and low minima a week before the larva pupates lengthens the ensuing pupal stage. Similarly, after eliminating the effect of temperature, a high negative correlation exists between soil moisture and pupal duration at these other times of the year: within limits, the moisture relationship holds regardless of temperatures. Actually there was very little difference between minimum soil temperatures of this and other dry seasons and it can only be concluded that the increased moisture induced an earlier break-up of dormancy in many of the pupæ. Parry Jones* recently published evidence that soil moisture is a determining factor with regard to emergence of American bollworm moths in the dry season at Mazoe, Southern Rhodesia.

In the present instance only part of the pupæ were affected and the peaks of emergence occurred as usual in August and September, emergence from carry-over pupæ ceasing on November 5th, as compared with November 2nd, November 5th, and October 28th in the three previous years. In effect there was more bollworm activity than is customary in the early winter months, leading to earlier and heavier flights of moths bred in winter crops. This was followed by activity on a generally increased scale over the accustomed months in the dry season. But there is every indication that all moths from these sources (Flight No. 1 in the sequence) will have finished oviposition by mid-December, whereas the corresponding dates in the three preceding years were December 9th, 14th and 17th.

We are concerned mostly with events leading to the appearance of moths in cotton and other summer crops, particularly those events immediately antecedent. Bollworm behaviour at the time of the departure discussed is of least importance in the annual cycle and it is clear that the timing of subsequent occurrences accords with earlier information.

Anatomical and Histological Studies of Egg Formation with reference to the Egg-laying Habits of the Moth.—In connection with previous observations on the egg-laying habits of individual moths, Mr. B. L.

* The over-wintering Pupa of *Heliothis armigera*, Hubn. (*Obsoleta*, fabr.). Effect of Temperature and Moisture.

The British South Africa Company Mazoe Citrus Experiment Station. Pub. No. 6a. 1937.

Mitchell was able to examine the development of the ovaries from the formation of the pupa to emergence of the adult. Amongst other observations he found that most, if not all, of the ovules are differentiated by the first day after pupation. Growth of the ovules is steady and continuous to emergence of the moth, but at the time of emergence no ovules had reached the lower part of the ovarioles. In fed moths the ovarioles swell rapidly and ripe eggs are present on the second day following emergence. Mating was not found to occur before the fourth day and then only if both sexes had taken food (nectar). Mating stimulated egg-laying.

Owing to losses of material from virus disease and other circumstances, the investigation could not include a series of examinations intended to throw light on the discrete mode of egg delivery commonly evidenced in the laying life of individual moths, of which interpretation is required.

Mitchell also reports that histolysis of the larval fat body begins in the pupa one day after normal pupation and occupies about six days. Building up of the digitate fat body of the adult commences about the seventh day : through a hand lens this is visible in the living pupa and since, according to Mitchell, a pupa entering a long pupation stage remains for a more or less protracted period in the same condition as a newly formed pupa, it is possible to determine readily whether or not a living pupa is diapausing.

Studies on Mortality.—The general bearing of this work was indicated in last year's Report. The studies have been continued on more intensive lines and some additional considerations are as follows :—

As the weight of egg-laying fluctuates over the seasons, and as examinations are made of the bollworm relationships with crops of each kind in successive plantings, it follows that records are taken of egg and larval mortality in populations of varying density. It is thus possible to evaluate the breeding propensity of each of several types of crop to better advantage, giving due regard to such varying factors as competition, virus disease, seasonal activity of parasites, predators, etc. There is now some evidence as to when disease is most prevalent, and records of parasite intervention have long been a feature of the survey work. The present-day approach to the problem, therefore, is to weigh and compare the breeding propensity of one kind of crop with another on different occasions, and as circumstances change, in the season of their growth.

Cotton and maize may serve as examples. The fruiting period of cotton of course occupies the greater part of the summer season,

but it is liable to be visited by three waves of bollworm of varying intensity. It should also be borne in mind that the planting dates vary widely from season to season. Against this we may compare at least three maize crops successively planted. Larval survivals, computed and compared on each of the occasions offered, go far to establish, as stated in the last Report, whether in manipulating the plantings of maize and other familiar crops, or by the insertion of new crops into the planting programme in order to attract moths from cotton, we have or have not thereby increased the bollworm population over the season.

In this work we are concerned to compare breeding propensity on the basis of total matured larvæ, that being the nearest we can approach in the field to estimates of potential moths, with the exception of some evidence on pupal mortality. There is, however, another aspect of the problem upon which information is being gathered. The curve of larval survival in several kinds of food-crop displays a high figure for survivals from the early and generally less abundant egg-laying, but falls away rapidly to very small figures, there being frequently no maturation of larvæ derived from eggs hatching at the peak of oviposition and subsequently. In other food-crops the curves of percentage survival are prolonged at more or less high levels, even for figures applicable to the periods of high egg-laying, with corresponding enhancement of their importance: these are cases indicative of crops with a high breeding propensity. It is hoped from information on these lines to classify the various food-crops in our survey in the connection with which the discussion deals.

Studies on Nutrition.—Particular attention has been given in the past year to observations on the class of food eaten by larvæ under natural conditions on growing crops, each individual record giving the growth stage of the worm. In this way it has been possible to learn fairly accurately where food is taken and how food in different categories is sought by the developing larvæ. By assembling frequency distributions of food classes on the appropriate dates of record and applying to them the corresponding frequency distributions, by instars, of the attending larval population, one has, for each type of food-crop, the natural "diet sheet." These data, when depicted diagrammatically with the flowering and egg-laying curves, afford a means of calculating the range of food available to larvæ from each batch of eggs laid nightly. A principal advantage of the information is that insectary tests on the nutritive value of food offering on food-plants of differing growth habits may be simulated closely and better direction given, when opportunity arises, for the translation by analytical means of many

empirical data into chemical terms and physiological effects. On the other hand mere presentation of the situation with respect to time intervals between the arrival of advanced larvæ and presence of (possibly) needed food does suggest reasons for low survivals of the larval population in certain crops. Other questions of food quality as they concern larvæ are the influences of food on pupal weight and the ultimate moths, which continue to receive attention.

The Course of Crop Production in Cotton in Relation to Losses from Bollworm Attack.—During the past two years much attention has been devoted to examinations in detail of the damage occasioned by bollworm. Where on the plant does the loss of fruit fall and what relation does the loss of fruit in particular sectors of the plant bear to ultimate yield? The work has necessitated the recording of all bud and boll histories on each of a number of sample plants, with a parallel record of bollworm egg and larval populations. In both seasons the observations were repeated in three fields in the hope (which was realized) of recording conditions under different weights of bollworm attack. With such detailed examinations, handling effect was inevitable, especially in the first year's work when all fruit was tagged. Handling, however, was greatly reduced in the past season by a change of method, but the influence of moisture shortage in restricting the later season fruiting militated against proper comparisons of yields from handled and unhandled plants. In the coming season it is intended, in conjunction with observations to be made by the Plant Breeding Section, to compare information with theirs when based on samples drawn periodically.

The results to date tend to affirm the importance of protecting the earlier formed bolls from bollworm attack. It is appreciated, however, that the influence of the growth conditions for the season, fruiting habits of individual strains, and other factors, particularly improvements in technique, necessitate long continued investigation of this subject before conclusions can be drawn.

Estimations of the Insect Community in Cotton and Maize Crops.—Information is required on the species of insects inhabiting food-crops of the bollworm, with regard to predators and alternative hosts of various parasites of the bollworm. In addition there are several minor pests of cotton and other crops present, of which very little is known here. Other insects, although not attacking the crops directly, are suspected of aggravating the damage caused by insect pests.

Quantitative estimates at regular intervals were desirable in order to study population trends. In the present instance chief importance was attached to predators, especially their seasonal abundance which

might be cumulative. Information on this subject would assist in the work discussed above under Studies on Mortality where the seasonal aspect is stressed.

This, the preliminary endeavour, was applied mainly to the cotton crop. A measured quantity of liquid cyanide was placed at the foot of a plant and a canvas cage was fitted quickly over and left in position for a determined period. Collections were then made of all insects fallen on to a ground sheet and of those remaining on the plant's surface, the process being repeated for all plants in the sample. Collections in this manner were made at weekly intervals, each being analyzed and the representatives counted.

Counts of the less fleet insects were probably fairly accurate and a good deal of useful information was obtained. For the first time we have the proper designation of some thirty of the species inhabiting the crops, and we are indebted to the authorities at the Imperial Institute of Entomology and the Natural History Museum for many identifications.

The figures from cotton have not as yet been examined statistically, but it would appear from ordinary inspection of them that there was no indication of rising numbers of the known predators. The method was inapplicable to maize plants. Visual counts were made in maize and when possible insects were captured by hand.

INVESTIGATIONS IN SWAZILAND ON THE RED BOLLWORM.

BY

F. S. PARSONS AND H. HUTCHINSON.

It may be repeated that the St. Phillip's Mission Station is situated in an area where typical colonies of the two wild food-plants of the bollworm, *Cienfuegosia Hildebrandtii* and wild cotton (*Gossypium herbaceum*) are present in natural plant associations. No cotton is planted in the neighbourhood and it is thus possible to investigate the natural course of breeding, and a number of associated events, without complications arising from bollworm bred in cultivated cotton.

Plant Development Records and Bollworm Breeding.—The St. Phillip's district is ordinarily rather arid. The season 1936–37 was an exception in being really wet throughout. As a result, the growth and fruiting behaviour of the food-plants in both that and the following season were affected. For 1936–37 everything was on a magnified scale, but the sequence of events was comparatively unaltered. A high soil moisture content persisting through the winter months, however, induced an uncommonly early and luxurious growth, which was sustained for a time by good rains in October. In the better soils of a riverside site *Cienfuegosia* plants were bolling heavily from late August (a month earlier than is usual for extensive growth) to December.

Other colonies of this plant in less advantageous surroundings commenced fruiting in September, but there too bolling until December was most extensive. Previously wild cotton had produced its first green bolls about mid-January, but in the past season considerable quantities of bolls were present in November and December.

Practically no rain fell between October 8th and December 19th so growth was supported very largely by moisture remaining from the previous wet season. With the depletion of moisture, bolling in all *Cienfuegosia* colonies terminated abruptly in December. Probably because of the later start and owing to benefit from light rains between December 17th and December 23rd, wild cotton continued to boll until the end of January; bolling then ceased abruptly. Wholesale shedding accompanied the falling off in fruit production.

After rains in late December and January a fresh crop commenced to form on *Cienfuegosia* and wild cotton, and subsequent growth behaviour was comparable with that of the two preceding seasons.

These circumstances are mentioned as they introduced the following additional conceptions of the complementary role played by the two food-plants, viz.:—As they emerge, moths from long-resting pupæ formed between March and June lay eggs on the earlier fruiting *Cienfuegosia* and a generation of the bollworm is produced before wild cotton bears fruit to sustain larvæ. This fact has importance when areas are under consideration where wild cotton is the sole or predominating natural food-plant, as there the infestation is built up on a later and lower plane, because the infestation on wild cotton so situated is initiated by moths in the tail-end of the flights from overwintering pupæ. Where colonies of both plants occur in the same neighbourhood, the bulk of the moths emerging from the overwintering pupæ in the cotton colony areas can find adequate food materials on *Cienfuegosia*, as no doubt they did in August, September, October and a portion of November last year. As food is usually abundantly progressive on *Cienfuegosia*, moths bred from the first generation continue oviposition in the colonies of this plant, although later in the year there is probably movement of moths to and from wild cotton.

Between December 30th and January 30th of the season under review there was practically no oviposition due to moths from whatever source, but particularly from the generation referred to above, on *Cienfuegosia* plants in the drier colony areas, these plants then being in a fruitless condition. But, by virtue of the circumstances mentioned, wild cotton was *unseasonably* in fruit over the period in question and served to bridge the gap until *Cienfuegosia* resumed fruiting, as was indicated by the oviposition on wild cotton at the time: the roles

with respect to the early breeding propensities of the two food-plants were reversed to this extent. Other factors concerning the situation in these colonies are discussed under Pupal Mortality. *Cienfuegosia* plants in a riverside soil with better moisture-holding properties retained some fruit and were fresher in the December-January period. There the expected moth flights were evidenced by the ensuing oviposition and there was the customary continuity of breeding.

It may be remarked here that the fruiting habits of *Cienfuegosia Hildebrandtii* in the dry and rainy seasons differ. Towards the close of the dry season, and before leaves are exerted, small flower buds appear. These never attain to half the size of an ordinary (summer-time) flower bud before (cleistogamous) fertilization occurs. Normal bolls develop from these buds and a heavy crop of them is set before there is the barest minimum of leaf area. It is in this fruit that the first generation of the red bollworm breeds. After rains and the formation of a copious leaf area, flower buds develop to large open flowers and fertilization and bolling proceed in the ordinary manner.

Pupal Mortality.—Heretofore moth emergence from pupal cages, designed to exclude predators, has been utilized in determining the annual course of moth flights. Owing to predatory and other agencies discrepancies are to be expected between the proportions of moths emerging from pupæ in protected cages and those in the field, although it was not expected that the times of flight or the general shape of the curves would differ greatly. Moth emergence as based on information from the cages has not, however, always conformed to the trend of egg-laying observed in the field either in time or quantity. In view of this we have established parallel series of observations on pupæ in field sites; individual cages are still used, but predators may enter and such factors as soil and moisture differences are allowed full expression.

The results at present to hand concern the fate of the over-wintering pupæ. Emergence in the riverside soil area referred to above had much the same distribution as that in the cages, although there were earlier emergences in the field. Emergences per unit quantity of pupæ were three times greater in protected cages than they were in the field. It appears from samples of the field pupæ drawn monthly that some 42 per cent. were destroyed by ants (*Pheidole* spp. ?), many before June and others in late August and September onwards: in the intervening period ants are least active. In both the protected cages and those in the riverside sites pupæ formed late in May (*i.e.*, from the last considerable populations of larvæ at the close of bollworm activity) contributed the highest proportions of moths. These pupæ would be least exposed to ants when forming and possibly be less likely

to be attacked on the resumption of ant activity, especially in a prolonged cool season. Emergence from drier sites and those with a less readily penetrable soil has been much delayed. Examinations are incomplete, but it appears that in the drier sites heavier mortality and delayed break-up of dormancy have occurred ; the effects of these have still to be determined.

Larval Mortality.—Comparisons of the breeding status of the two food-plants have been continued.

In 1936–37 all the breeding on wild cotton occurred after January 31st. In the following season, because of the diversion of moths from *Cienfuegosia* to wild cotton in January, fully half of the larvæ bred on cotton over the whole season accrued from the January oviposition. The proportions of larvæ matured in both seasons were 3·2 and 3·4 per cent. respectively.

The percentage of survivals in three types of *Cienfuegosia* colonies, (1) a riverside situation, (2) the borders of a pan (wet) and (3) a comparatively dry ridge site, were 6 per cent., 6·1 per cent., and 8·5 per cent. respectively. These percentages are based on total matured larvæ. The survival for the season in *Cienfuegosia* colonies was 1·5 times higher than last year (1936–37), although the hatched eggs which formed the basis of the estimates numbered 5,499 in 1936–37 as against 5,491 in 1937–38. No egg or larval parasites have been encountered in three years of survey and the explanation of the higher survival probably lies in the fact that records were transferred in 1937 to larger colonies of larger and more fruitful plants, where predators may be less concentrated.

INVESTIGATIONS AT MAGUT, NATAL, ON THE AMERICAN AND RED BOLLWORMS.

The observations and experiments discussed in this section of the report have been carried out by Mr. P. A. Bowmaker in collaboration with workers in the Insect Pest Department in Barberton.

AMERICAN BOLLWORM.

Combined Spacing and Cotton Variety Test.—Three strains of U.4 with differing fruiting habits were set out in suitable repetitions at one, three and six foot intra-row spacings. The experiment was designed to study relationships between stainer, bollworm and plant populations and any differences in damage resulting from combinations of varying populations both plant and insect. The results regarding stainer are discussed in Mr. Pearson's Report which follows (page 42.)

The rains were late at Magut and the experiment could not be planted until the end of December. Egg-laying due in this case to

moths of the second summer generation commenced in March, when oviposition was at the maximum. This was unfortunate as the major laying occurred before differences between plants, as induced by spacing, had become evident. At this time egg numbers per plant were highest in the one-foot spacings, which afforded the best cover. The later egg-laying was really too light to enable conclusions to be drawn. The experiment is being repeated.

Hand Collecting Experiment.—The possibilities of hand control of insect pests in small areas of cotton merit more attention than they appear to have received. Workers in native cotton-growing areas are divided in their opinions on the use of hand control, particularly as to whether or not natives could be persuaded to employ and adhere to a collecting programme.

Pending systematic attempts to test that question with Mr. Mitchell's help in Nyasaland, Mr. Bowmaker has carried out a preliminary experiment on the value of hand control in terms of increased yield, using an adaptation of the half-drill-strip method for comparison. The hand-controlled plots gave a significant increase in yield of 105 lbs. seed cotton per acre.

In this connection labour, time and other factors have received attention. The tests which refer to both bollworms and to stainers are to be repeated.

Alternative Food Crops.—Gatooma *Dolichos* under test at Magut exhibited a much greater attraction for the egg-laying moth than at Barberton. It should be tested further in blocks with increased numbers of plants per unit area.

RED BOLLWORM.

Evasion of the bollworm in cotton planted under irrigation and fruiting in the off-season months.—In the Magut Report, comment is made on the relative growth-fruiting behaviour of the test areas of cotton planted successively. It remains to be stated that the corresponding association of the red bollworm was exactly as forecast on the basis of information on the course of natural breeding obtained on the wild food-plants at St. Phillip's, Swaziland, and in the Pongola River area. If stainer and American bollworm attacks do not develop too extensively, there is every reason to expect that good crops of cotton can be grown when planted (at a date to be determined) between January 30th and early March, without damage by red bollworm and without favouring an increase in red bollworm population with respect to future crops.

PROGRESS REPORT ON WORK IN INSECT PHYSIOLOGY, 1937-38.

BY

R. C. RAINEY.

Two and a half months were spent in England in the selection and purchase of equipment and in discussing the proposed research programme with leading investigators in the various fields concerned. Acknowledgements for valuable advice and generous assistance are due to members of the staffs of the Departments of Biochemistry, Entomology, Meteorology, and Instrument Design at the Imperial College of Science and Technology, the Departments of Entomology and Industrial Physiology at the London School of Tropical Medicine, the Instruments Department at the Meteorological Office, the Mazoe Citrus Experimental Station, the Marine Biological Laboratory, Plymouth, Rothamsted Experimental Station, and the Royal Observatory, Greenwich.

The first line of work undertaken was a meteorological investigation of conditions within the cotton crops. This was intended as an attempt to define the environmental conditions under which oviposition by the bollworm moth occurs, in order to decide to what extent the observed variation in oviposition from night to night is due to ecoclimatic factors which are capable of being modified artificially, for example by cultural methods. Unfortunately, oviposition on the area sampled this season was too light to supply data statistically adequate for this purpose; the work is to be repeated and extended during the coming season. However, the experience gained with the instruments proved of service in the later dry-season stainer investigations, and, in conjunction with the latter, the summer records supply a useful indication of the range of conditions to which stainers are exposed in the course of the year. Information is also accumulating on the question of the relationship between the environmental conditions actually experienced by the insect and the climatic data supplied by standard meteorological observations. This relationship is of obvious importance in any attempt to apply the results of laboratory observations on the effects of controlled environmental conditions on the insect, to areas for which only standard meteorological data are available.

Some time was spent during the summer in collaboration with Mr. Pearson on field inoculation experiments with *Nematospora*, for the preparation of bolls showing standard degrees of staining, and in the investigation of varietal resistance. A visit to the Experimental Station at Magut was also made in order to see something of the stainer work in progress there—the field trials on the effects of variety and spacing on stainer, fungus, and crop, and the recording on wild host-plants and on irrigated cotton.

Preliminary work was carried out on the growth rates of the cotton boll from flowering to maturity ; since equipment was not available till late in the season, the material used was obtained from the late variety " 920 " and from stripped " 052 " plants. While the results are to that extent not typical, and are probably further affected by the *Alternaria* attack that was experienced, they form a useful foundation on which to plan an investigation of changes in chemical composition during the development of the boll, which it is proposed to attempt during the coming season as a basis for studies of the nutrition of bollworms, stainers, and *Nematospora*.

During the dry season attention has been concentrated on stainer problems, in view of the impending departure of Mr. Pearson for Nyasaland. Two lines of work have been pursued, both intended to assist in explaining the sharp rise in recorded stainer population which has been observed each year to follow the break of the rains.

The first is an investigation of the climatic conditions to which stainers are subjected during the dry season in a typical wild host site and in possible hibernation sites, with a view to obtaining data for use in conjunction with laboratory observations on the effects of controlled environmental conditions on stainer development. Full results are not yet available, but the range of ecoclimatic conditions already shown is striking ; thus within a clump of *Hibiscus calyphyllus* conditions were at times almost desert-like in aridity and in diurnal temperature range during the last week in July, minimum relative humidities down to 9% being recorded, with air temperatures ranging from 1° to 34° C. (34° to 93° F.), while beneath soil debris a foot or two away from the *Hibiscus* the relative humidity over the same period did not fall below 71%, and the temperature range was only from 10° to 17° C. (50° to 62° F.).

The second line of work is an investigation of the changes in food reserves, particularly fats and proteins, in stainers on different diets during the dry season in order to throw light on the considerable differences observed between different species and treatments in the survival experiments. Both these lines of work are discussed further in the stainer report ; in the case of the second, attention may be drawn to the way in which biochemical observations, such as those on the marked difference between *Dysdercus fasciatus* and *D. nigrofasciatus* in ability to synthesise fat from carbohydrate, can assist in explaining differences in the ecology of the two species.

Work is also in progress on the influence of different host plants, and of different stages in fruiting development of the same plant, on the size and food reserves of American boll-worm pupæ. Results

already available demonstrate clearly that in the case of beans access to advanced green fruit is essential for the development of the full potential size of the pupæ, while with peas no significant differences in nutritive value appeared between any of the fruiting stages chosen, a fact which may be associated with the higher rates of larval mortality observed on the former host.

INVESTIGATIONS ON COTTON STAINERS AND INTERNAL BOLL DISEASE.

BY

E. O. PEARSON.

During the past season the recording work on wild host plants and in the crop in Swaziland has been carried out under Mr. Hutchinson and in the Magut district under Mr. Bowmaker.

Observations on Wild Host Plants.—Recording of stainer populations on wild host plants, using the methods evolved during the preceding two years, continued in the Barberton district, in the Swaziland middle veld, at St. Phillip's Station and in the Ingwavuma and Pongola valley districts, the last especially in connection with experiments in progress on irrigated cotton.

The general course of events on these hosts was similar to that outlined in last year's report: on *Hibiscus calyphyllus*, following a sharp rise in adult population of *D. nigrofasciatus* due to immigration in November, successive generations developed at approximately two monthly intervals, the numbers gradually falling off after June. The generations overlapped to a greater extent than last year and there was also much variation in the time of occurrence, from one locality to another, depending on the local rainfall conditions. The most striking difference in the records for the Barberton district in the two past years was in the extent to which breeding was maintained during the dry season, as the following table shows:—

POPULATIONS OF *D. nigrofasciatus* ON SAMPLE BEATS OF *H. calyphyllus*, BARBERTON DISTRICT, JUNE-AUGUST INCLUSIVE.

Year.				Total Population recorded per week.	Young Nymphs as % of Total Population.	Rainfall (inches).
1937...	...	...	...	129	12.6	0.10
1938...	...	...	...	580	42.5	3.39

The population of young nymphs (instars II to IV) was thus fifteen times as large in this as in the 1937 dry season. These years happen very conveniently to be the wettest and the driest "dry" seasons ever recorded on the Cotton Station.

The results on other herbaceous host plants were of somewhat the same nature, populations being in all cases carried on much later than heretofore into the dry season.

Records on *Sterculia Rogersii* were carried on in the Barberton district only, where as usual *D. intermedius* was the main immigrant, flying in during November and maturing a generation in early January, *D. nigrofasciatus* being completely absent in three out of the four recording colonies.

D. fasciatus was almost completely absent from wild host plants, occurring in small numbers in the Ingwavuma district only, chiefly on *H. dongolensis*. Adequate records on wild cotton (*Gossypium herbaceum* var. *africanum*) and *Cienfuegosia Hildebrandtii*, which on account of their close relationship to cultivated cotton were under suspicion, have established the fact that these plants do not in fact constitute a normal host of *D. fasciatus* in this country. Last year's conclusions on these points are thus confirmed.

Stainer Marking Experiments.—In an attempt to obtain information on the true, as against the observed, populations of adults on wild host plant beats, and on the variations in the death and dispersal rates under natural conditions, a marking experiment was carried out on lines similar to those used for the study of tsetse flies in Tanganyika (Jackson, 1936).¹

A typical *H. calyphyllus* locality was selected in bush country 14 miles from Barberton, consisting of a beat 0.66 miles long following an intermittent stream, topographically isolated from other similar areas and well away from cotton. At weekly intervals all adult stainers found on this beat were marked with paint on the pronotum, using a different colour each week, and released, a record being kept of the number marked and of the marks already carried by them. The details are too technical to permit of full discussion here, but, briefly, it can be shown that on the average the recaptures of stainers in successive weeks from an original marking fall away in an approximately geometric progression and hence that by extrapolation it is possible to determine what proportion of the population actually present on the original occasion was in fact marked. Over the whole season's markings this proportion averaged 30%.

The numbers available in this experiment were not really large enough, and the area sampled was too small in comparison with the dispersal range of the insect, to give very reliable estimates of true populations, but it is believed that with modifications and extensions the method will prove invaluable in estimating true stainer populations in circumstances where an accurate *direct* sampling is impossible, as on such unwieldy units as baobab or *Sterculia triphaca*.

The most striking feature of the experiment was the fact that although on the average 30% of the population actually present was

recorded each week (*i.e.*, one stainer in every three was captured) the percentage of the original marked population recaptured in successive weeks fell so rapidly.

Weeks after marking ...	1	2	3	4	5	6	7
Percentage recaptured ...	9.09	3.52	1.54	0.73	0.45	0.24	0.09

This decline is due to deaths and to dispersal from the area, but since these figures are far below those computed from the known death rate on this host under laboratory conditions, they must represent largely the effects of dispersal. Over the whole season a figure of the order of 40–50% is suggested as the percentage dispersal per week.

During the months January–April inclusive, however, when breeding on this host is at its maximum, the percentage of recaptures fell off much more rapidly than the average figures given above, suggesting that the time of maximum breeding is also the time of maximum rate of dispersal.* The reason for this is not yet understood, but it introduces a new conception to our knowledge of stainer behaviour, since it was previously believed (see 1936–37 report, p. 36) that dispersal occurred only when conditions on the host plant were becoming unfavourable. It now appears that dispersal is almost always in progress, but that on hosts in a favourable condition this dispersal is offset by arrivals from other areas, the net population being maintained, whereas on hosts which are going off dispersal is not offset by immigration and a decline in population is observed.

Records in Cotton.—In addition to records in experimental crops on the Pongola valley scheme, reference to which will be found in the report from Magut, stainer populations were recorded at points in the Barberton valley, the Barberton district bushveld, the Swaziland middle and low veld, and at Magut.

On the Barberton Cotton Station *D. fasciatus* reached a peak immigration figure of 150 per acre, a rather larger figure than has been recorded for some years, which was derived from fields of standover cotton on a neighbouring farm, and the F_1 bred up reached over 2,000 per acre. At Magut, after last year's disastrous experience with this species bred in standover cotton, the neighbourhood was cleaned up, and populations returned to their normal level.

* It is also possible that this decline might represent a seasonal variation in parasitism. Whilst parasitism by Tachinid flies is not uncommon here under certain conditions, it has never been observed to a degree sufficient to explain a phenomenon of the order of the present one. But in view of the importance of the point and of the fact that parasitism of *D. nigrofasciatus* in Uganda on its wild hosts is said to be so heavy, detailed records of parasitism are being kept during the coming season.

Except on the Cotton Station, Barberton, where the peak immigration figure of *D. nigrofasciatus* was 400 per acre, reached on March 24th, immigrations of this species were a good deal larger and later than normal, from 1,400 to 6,000 per acre, varying in their time of occurrence from mid-March to the end of April. The staining was similarly of rather a high order, averaging about 25%.

Events in Northern Swaziland were similar to preceding years—a prolonged immigration, reaching a peak of over 2,000 per acre, extending from mid-February to the end of March. Mr. Hutchinson has carried out an intensive survey this season on the ecology of *Hibiscus Trionum* and *H. cannabinus* occurring as weeds of native cultivation in this district, and this has shown that the host plants occur in sufficient quantity to be a very important possible factor in stainer bionomics in native areas. However, contrary to previous indications, there was no possibility this year of the population in cotton having been derived from a generation bred up in *H. Trionum*, since the immigration to the two food plants was in fact almost contemporaneous. From knowledge gained of the density of the immigrant population in sample native areas, it was clear that, assuming a slight concentration effect, the immigrants reaching cotton were part of the same flight as that which reached *H. Trionum*. The work is being continued in the hope that last season's disappointing results were due to an unusual combination of circumstances. The question is also bound up with the possibility of concentration effect on small experimental areas and an experiment on this point, which failed last year on account of poor growth, is being repeated this season by Mr. Hutchinson.

The July-November gap.—There are at the moment two theories as to the manner in which *D. nigrofasciatus* survives the dry season from July to November, first that a generation intervenes on *Dombeya rotundifolia*, and secondly that adults from the tail-end of the previous season's breeding on herbaceous hosts survive directly until the start of the new season.

The position of *Dombeya* is being investigated again at the time of writing. Immigration took place through late July and August and adults in small numbers have been present throughout September; nymphs of the 2nd and 3rd instar appeared in early October in the Barberton district, but it is as yet too early to say whether these will succeed in maturing a generation before the seasonal rise in adult population on herbaceous hosts.

The results of this dry season's survival experiments, however, have suggested a re-examination of the possibility of direct survival.

Last year the experiment was conducted with adults collected in the field and thus of unknown age at the start of the trials. This year all the trials were carried out using freshly moulted adults of approximately the same date. The results are summarized below :—

PERCENTAGE SURVIVAL UNDER INSECTARY CONDITIONS OF *D. fasciatus* AND *D. nigrofasciatus*
ON DIFFERENT FOODS, STARTED EARLY JUNE, 1938.

Age in Weeks.	<i>D. fasciatus.</i>			<i>D. nigrofasciatus.</i>		
	Water and Seed Cotton.	Water and Nectar.	Water only.	Water and Seed Cotton.	Water and Nectar.	Water only.
2 ...	99	97	96	99	99	97
4 ...	93	91	92	97	93	93
6 ...	68	76	42	90	88	85
8 ...	40	48	1	77	84	58
10 ...	17	25	—	57	78	35
12 ...	1	10	—	33	64	15
14 ...	—	1	—	21	38	1
16 ...	—	—	—	13	22	—
18 ...	—	—	—	6	9	—

If these survival figures are applied to the freshly moulted adults derived from the known populations of 5th instar recorded on the wild host beats at various dates from June onwards, it can be shown that adults produced late in the previous season may be surviving in the following November in numbers comparable with those constituting the November flight. The possibility is enhanced when one remembers that the survival figures are based on insectary conditions, which are comparable, as regards temperature and humidity, with those recorded in the standard screen. The climatic investigations mentioned later show that in the field situations exist which are very much more favourable to survival.

It will be observed that, in the case of *D. nigrofasciatus*, there is little difference in survival rates on different foods until after six weeks of age. Adults produced in mid-June are thus able to survive comfortably on water, which the climatic work shows to be freely available in the form of dew at this time of year, until the end of July ; by that time *Dombeya* and other trees and shrubs are coming into flower and supplies of nectar are available.

It is of interest that although mating occurred sporadically on diets of nectar and water, not a single female became pregnant, whereas on seed-cotton pregnancy occurred at two to three weeks of age and egg laying followed. The death rates for males and females of both species on nectar and on water were approximately the same, but when fed on seed-cotton the female death rate rose sharply at the conclusion of egg laying.

Food Reserves in Overwintering Adults.—In connection with these survival experiments a study of the food reserves of adult males fed on water only and on nectar and water was made in collaboration with Dr. Rainey. Samples of the surviving population were taken at

fortnightly intervals throughout the experiment and individual determinations made of water content and of ether extract. Measurements of pronotal width were also made on all stainers used with a view to eliminating from the results the effects of varying size.

Dr. Rainey also undertook duplicate determinations of total true fat, by a saponification method, and of crude ether extract, on similar material from two samples with widely differing fat contents, in order to find out to what extent ether extract can be regarded as a measure of the true fat present. He also made nitrogen determinations on a smaller, picked sample of the extracted individuals.

The results of these investigations are not yet fully available, but the following points may be mentioned. Dry weights after ether extraction decline in much the same way in both water and nectar-fed stainers; they fall off rapidly at first, but the decline later becomes much more gradual; this point is reached earlier in *D. fasciatus* than in *D. nigrofasciatus*. The nitrogen determinations so far available show a decline in close agreement with that to be expected on the assumption that the fall in extracted dry weight represents a utilisation of protein.

Weights of fat decline in a similar manner to non-fatty dry weights in the case of water-fed stainers of both species—rapidly at first and later approaching a steady level; the death rate rises steeply as these basic levels are reached.

In the case of nectar-fed stainers there is a striking difference between the species; in *D. fasciatus* fat weights behave in much the same way as in water-fed individuals, except that the initial rate of fall is not so great and the basic level reached is rather higher; in *D. nigrofasciatus*, on the other hand, after a sharp decline in the first fortnight, the fat content increases and at ten weeks of age is practically at the original starting value. As at that time the great bulk of the population is still living, this result cannot be a fictitious one due to natural selection of individuals with high fat contents. *D. nigrofasciatus* therefore possesses to a marked extent the ability to synthesise fat from monosaccharides, a characteristic shared only in very slight degree by *D. fasciatus*. This difference is reflected in the survival figures for the two species on nectar, and goes far to explain our observations here that the species found visiting flowering trees and shrubs in the late dry season is almost exclusively *D. nigrofasciatus*, even where the other species may be present in abundance in the vicinity.

Feeding experiments.—With a view to determining the length of life of the different species on different wild host foods, experiments were carried out in the wet season in the insectary under conditions approximating to those in the field.

The results were a little surprising. *D. nigrofasciatus* developed most rapidly** and most successfully, as measured by live weights of individuals less than 24 hours old, on seeds of baobab and *Thespesia Rogersii*† (on which this species is rarely, if ever, found), *Sterculia Rogersii* and cultivated cotton. Development took about a week longer and live weights averaged only two-thirds as much on the commoner species of *Hibiscus*, whilst on *Dombeya rotundifolia* development took twice as long and there was heavy mortality. *D. fasciatus*, as would be expected, likewise developed most rapidly and successfully on seed of cotton and the arboreal hosts, but it also succeeded in maturing, with a longer developmental period and a reduced live weight, on the commoner *Hibiscus* species, on which it is so rarely found in this country. It is of interest, however, that within the *Hibiscus* species, the development period was shorter and adult live weights were greater on *H. dongolensis* and *H. vitifolius*, which are preferred hosts in other countries, than on *H. calyphyllus*, and that whilst mating and egg production occurred freely on the former they were to a great extent inhibited on the latter.

Incubation Experiments.—Whilst it has not been possible to find time to study the effects of temperature and humidity over the whole life cycle of *Dysdercus*, a preliminary study has been made of the effects of these factors on the egg and first instar stages, which constitute the most susceptible phase in the insect's life, and the results are given below.

(a) *Effect of Humidity at Constant Temperature.*—Eggs of *D. fasciatus* were maintained at a constant temperature of 80° F. and subjected to a range of relative humidities, controlled by solutions of sulphuric acid, from 10% to 100%. Humidities above 70% exercised no effect on the percentage hatching, but below that figure hatchings fell rapidly and at 50% humidity none occurred. A certain amount of development was visible in eggs at this and lower humidities, suggesting that the question of whether or not hatching occurs is controlled by the difference between the rates of development and of desiccation: it is thus possible that at lower temperatures lower saturation deficiencies would be lethal, a fact of prime importance in the cool weather of July.

At relative humidities below 90%, in the absence of free water, 1st instar nymphs failed to survive.

** About four weeks, from the start of the 2nd instar to the final moult.

† Seed supplied by Mr. Ducker from the Lake shore area in Nyasaland. It is of interest that the seeds of *Thespesia* were found to be infected with *Nematosporea gossypii*.

(b) *Effect of Temperature at Constant Humidities of 100%.*—Experiments were carried out on eggs of both *D. fasciatus* and *D. nigrofasciatus* exposed to a range of temperatures from 9° to 43° C. maintained by a multiple temperature incubator.

The lowest constant temperature at which hatching occurred was 16.3° C. (61.4° F.) in both species. At the next lower temperature used, 14.8° C. (58.6° F.) no hatching occurred. The threshold of development must lie between these limits.

The lower fatal limit was explored for *D. nigrofasciatus* only. Five days' exposure to temperatures from 11° C. (51.8° F.) downwards was fatal, no hatching occurring when eggs were subsequently removed to an optimum temperature. After five-day exposures to 12.2° C. (54.0° F.) and 14.4° C. (57.9° F.), 22% and 36% respectively hatched when the temperature was subsequently raised to the optimum. The lower fatal limit of temperature is thus extraordinarily high.

At constant temperatures above 30.3° C. (86.5° F.) no hatchings occurred in either species. Exposures of newly laid eggs of *D. nigrofasciatus* for 1 hour to 36.8° C. (98.2° F.) was fatal, exposure to 34.2° C. (93.5° F.) for 1 hour resulted in 54% hatching. Eggs of both species were able to withstand much higher temperatures when 5 days old, 38.6° C. (101.5° F.) for 1 hour was not fatal, but 42.6° C. (108.6° F.) was.

Exposures for twenty-four hours to temperatures of 31.5° C. (88.6° F.) and upwards were fatal to new laid eggs of both species, but five-day old eggs again withstood higher temperatures, 34.0° C. (93.2° F.) was not fatal, whilst 35.5° C. (95.9° F.) was.

Within the range 16° C. to 30° C. the incubation period of eggs of *D. nigrofasciatus* gave a close fit to the equation

$$\log_{10}P = K/T$$

where P. is the incubation period in days, T. is the temperature in degrees C. and K. is a constant whose value is 21.5.

Climate Recording Work.—The recording of eco-climates which was mentioned in last year's report was concluded after 12 months' continuous observations in four sites representing the range occupied by the commoner host plants. As a result we now have a fairly good idea of the conditions of temperature under which the stainer population is living and of the relation in this respect of different host plant situations to standard screen conditions throughout the season.

The humidity measurements were much less satisfactory, on account of the fact that paper hygrometers, used because they were the only instruments small and simple enough for the work, were

subject to very large errors, impossible to overcome without more frequent calibrations than it was feasible to make.

Nevertheless, some idea of seasonal and diurnal fluctuations within and between situations was obtained.

The special importance of dry season climatic conditions made further and more accurate and intensive work advisable and from July onwards, in collaboration with Dr. Rainey, this has been carried out in one of the original sites used for the exploratory work. This is situated in a large clump of *H. calyphyllus* in a typical habitat and was chosen to represent the best conditions available to stainers at this time of year. The instruments used in the first year's work were maintained in their original positions and were augmented by accurate recording instruments and by specially conditioned hygrometers used only for short periods over a limited range of humidities. This work is still in progress. In addition to showing that the somewhat primitive methods used in the exploratory work can in fact give reliable results, we now know with comparative accuracy the most favourable conditions which can be experienced during the dry season by stainers in this country.

Field Experiments.—Since 1933 experiments have regularly been carried out with the object of (1) determining accurately the relation between stainer and crop populations and the resultant damage due to internal boll disease, and (2) exploring the possibility of intervarietal differences in this respect. A somewhat similar experiment, but designed to include the effects of varying cover, obtained through using intra-row spacings at one, three and six feet, was carried out this year, but it failed to give results, like all its predecessors, chiefly by reason of the lack of immigrant stainers in sufficient numbers. Two of the varietal treatments had to be eliminated on account of an early attack of aphid and the whole of the remainder of the experiment was vitiated by a severe attack of *Alternaria* later in the season. These experiments, which have not hitherto been mentioned in the annual reports, represent an enormous amount of wasted effort, and it is hoped that conditions in Nyasaland will be more favourable to this extremely important work.

An identical experiment, however, was carried out this year by Mr. Bowmaker at Magut, and there, under better crop conditions and with an initial stainer population of 2,400 per acre, some extremely useful results were obtained. The statistical treatment of these results has been largely undertaken by Dr. Wickens. The main result has been to demonstrate statistically what has long been suggested, namely, that the amount of staining, governed in turn by the amount of

puncturing of bolls, does not necessarily follow the absolute stainer population, but depends on the stainer/boll ratio. There was no suggestion of any varietal differences in staining, puncturing or stainer population, but spacing had a significant effect on all these quantities, the closest spacings have the highest stainer populations, the highest stainer/boll ratio and the greatest degree of damage. A closer examination of the results, however, suggested that these differences were largely accounted for by the differences in earliness induced by spacing, and it follows that in order to test differences in cover it will be necessary to devise some method by which cover may be varied without any corresponding variation in earliness. Experiments to this end are now being designed.

In conjunction with these experiments a very large number of inoculations were made, using different strengths and dosages of *Nematospora gossypii*, on two varieties of U.4 in order to see whether detectable inter-varietal differences in direct resistance to the fungi of internal boll disease exist. A similar experiment was made some years ago, but on too small a scale for its negative results to be acceptable without confirmation. This year the material, which was taken rather late in the season, was wiped out by the severe drought and an attack of *Alternaria* that followed it. The plants became defoliated early and did not mature the bolls used in the experiment.

The need has been felt for some time for some method of assessing stainer damage possessing less arbitrary characters and covering a wider range than the grades which have been in use since 1934. Taking advantage of the fact that the degree of damage due to internal boll disease varies inversely with the age of the boll at the time of inoculation, a new series of grades was prepared this year by inoculating samples of sterile bolls at weekly intervals from flowering to maturity with a standard spore suspension of *Nematospora gossypii*.

The new grades are composed as follows :—

- | | | |
|------------|---|--|
| Grade O. | Nil or very slight discoloration. | Bolls inoculated at 7 weeks of age or upwards. |
| Grade I. | Light to moderate discoloration. | Bolls inoculated at 6 weeks of age. |
| Grade II. | Heavy discoloration and extensive breakdown of lint. | Bolls inoculated at 3–4 weeks old. |
| Grade III. | Partial to complete abortion of boll with much reduction in size and complete destruction of boll contents. | Bolls inoculated at 1 to 2 weeks of age. |

In connection with the inoculations on which these grades are based, duplicate samples were inoculated with sterile distilled water and it was found that whereas, after the age of three weeks has been attained, inoculation of 0.2 ccs. of sterile water per lock has no effect,

in bolls younger than this the damage is very severe, resulting, in bolls treated when 1 to 2 weeks old, in complete abortion.

Some subsidiary experiments were carried out, since it was suspected that the technique of inoculation might be faulty and that the effect might be due to mechanical injury by the syringe needle, but it was finally proved that the action was entirely due to the sterile water. Presumably the effect is due to plasmolysis and there appears to be a sharply defined point in the life of the boll, correlated with the stage of development of the embryo, at which the permeability of the ovule's integuments changes so as to render it resistant to this action.

REFERENCE :

¹Jackson, C. H. N. Some new methods in the study of *Glossina morsitans*. Proc. Zool. Soc. Lond. Part 4, 1936, p. 847.

COTTON EXPERIMENT STATION, MAGUT, NATAL. PROGRESS REPORT FOR THE SEASON 1937-1938.

BY

P. A. BOWMAKER.

SEASON AND GENERAL.

Planting rains were again late in arrival, the cotton experiments, seed plots and the first lot of rotation crops being sown during the last week of December. This lateness was, however, rather offset by the excellent growing conditions which prevailed until the end of February. During this period over seven inches of rain, which came at most suitable intervals, was registered. Growth during March was restricted by rather dry conditions, while fruiting was encouraged. Attacks of American and red bollworm were experienced during the first half of the month. A good rain early in April gave renewed vigour and, while a certain shedding of squares was the immediate result, cotton picking was continued well into August, which is abnormal for the district.

On account of the lateness of the planting rains and of the low price of cotton a reduced acreage was planted in the Magut area. Some very satisfactory yields were recorded, however, and it may be mentioned here that one block on the Station gave 440 lbs. of lint per acre, the highest yield recorded on the Station in eleven years.

Apart from the bollworm infestation, insect damage was slight. Stainers arrived in numbers in April, but general breeding did not occur until after the main crop had been picked.

The Department of Native Affairs of the Union Government continues to show an interest in cotton as a cash crop for use in the native areas of Natal. Ten observation plots, varying in size from $\frac{1}{4}$ to 2 acres, were grown by natives and several more by Europeans in various districts between Eshowe and Port Shepstone. In most cases the cotton did not do well, partly as a result of insect attack, mainly *D. nigrofasciatus*, and partly owing to unsuitable soil and climatic conditions. In several cases, however, the plots showed very definite promise. A further series of observation plots is to be planted in the coming season, extending them into areas that appear to be more generally suitable.

Five native probationer demonstrators were given a course of training in cotton-growing on the Station during the year, and have now been posted by the Department of Native Affairs as agricultural demonstrators in the Natal native areas.

COTTON.

Variety Tests.—Uniformity tests carried out at Barberton, where soil irregularity appears to be greater than at Magut, have shown two-row plots to be the best for variety trial purposes. Plots 90' $\times$ 2 rows were used at Magut, with 8 or 9 replicates and from 8 to 12 strains in each trial. Four trials were planted and brought to a successful conclusion. Results are given in Table 1.

As in previous years samples of seed cotton were sent to Barberton for examination for boll weight, ginning percentage and seed weight, and lint length.

That early strains have a very distinct advantage has been evident for several seasons and this was further demonstrated this year. It will be seen from Table 1 below that the later strains, 920 and 921 and their derivatives, fall far behind the earlier 052 group. After considering the poor showing of some of the late strains over a number of years, it has been decided, in consultation with the Barberton Station, to discard many of them finally. A strain that commonly does better at Magut than elsewhere is 998R and it has proved very good this year again.

TABLE I.

YIELDS OF LINT IN LBS. PER ACRE FROM STRAINS IN VARIETY TRIALS.

Strain and Percentage.	Trial No.			
	1	2	3	4
U.4.4- 045- 231 ...	178	228	—	—
„ 234 ...	—	217	—	—
„ 340-5119 ...	—	—	—	274
„ 341-5126 ...	—	—	—	244
„ 052 ...	189	254	240	259
„ 5141 ...	—	—	—	272
„ 5142 ...	—	—	—	264
„ 5143 ...	188	260	—	270
„ „ 6128 ...	—	—	—	265
„ „ 6130 ...	—	—	—	283
„ 5146-6135 ...	—	—	—	263
„ 5149 ...	201	257	—	282
„ 5156 ...	—	—	—	291
„ 5159 ...	—	—	—	273
„ 4.4.2-951R ...	—	258	—	—
„ „ 324 ...	—	250	—	—
„ 4.4.10-998R ...	215	283	—	—
U.4.2- 920 ...	—	—	185	—
„ 0268 ...	151	—	185	—
„ 0270 ...	155	—	208	—
„ „ 297 ...	—	—	212	—
921 ...	—	—	197	—
„ 096 ...	157	—	205	—
„ 3183 ...	—	—	192	—
„ 0101 ...	178	—	206	—
„ 266 ...	—	—	211	—
Sig. Diffce. P = .05 ...	20	27	19	25

Seed Multiplication.—Blocks of approximately $\frac{1}{4}$ acre each of all strains under test were planted for seed multiplication and gave satisfactory yields of very sound seed. The two strains 5143 and 5149,

which are considered to be the best of the 1935 re-selections from 052, were multiplied in acre blocks to give sufficient seed for issue to local farmers.

An outbreak of wilt disease on the Station, while confined to certain fields, involves a certain risk in issuing seed from the Station multiplication areas for use in the district. Accordingly, until more is known concerning the spread of this wilt, no seed is to be issued from the Station, and it is hoped to arrange for any seed multiplication for district issue to be effected by local farmers on wilt-free land.

Agronomic Trials.—The green manure experiment, comparing the effect on cotton of a previous cropping of sunnhemp green manure, sunnhemp seed and maize, gave a significant ($P=.01$) reduction in yield where the previous crop was sunnhemp seed. Yields from the other two treatments were identical.

A crop rotation experiment was concluded, and while yields ranged between 1,230 lbs. of seed cotton per acre, where the previous cropping was maize, to 1050 in the case of sunnhemp seed, no statistical significance attaches to the result. Intermediate yields were from land previously cropped to tepary beans, groundnuts, kaffir corn and soya beans.

For a repetition of both the above experiments in 1938–39 land has been satisfactorily prepared.

ROTATION CROPS.

A very useful weeding out of types not sufficiently resistant to drought was possible in the selections from the maize variety American White Flint. The small bulks taken the previous year were planted on 31st January, and gave good germination and early growth. Soil moisture was ample for maize requirements until shortly before flowering, when all lots were obviously feeling the drought. Flowering and grain formation were completed before April, when the drought conditions were broken.

It is thought that little further progress can be made in the remaining strains by single plant selection, and accordingly special bulks have been taken from these. The special bulks will be used in the 1938–39 season for variety tests and seed multiplication.

Field selection was carried out in blocks of Anveld, Peruvian Red and Synthetic No. 1. The last promises to suit local conditions, although, owing to an irregular stand, only a moderate yield was given in the year under review.

Yields from American White Flint strains and commercial varieties, to be considered in conjunction with the rainfall table at the end of this Report, are given in Table II.

TABLE II.
YIELDS FROM MAIZE BLOCKS, 1937-38.

<i>Planting date.</i>	<i>Strain.</i>	<i>Yield (lbs. grain per acre).</i>	<i>Remarks.</i>
30th Dec. 	Synthetic	1130	Indifferent stand
31st " 	Anveld	1070	" " "
" " 	A. W. Flint 426	1510	" " "
1st Jan. 	"	1360	" " "
2nd Feb. 	"	1220	Poor stand
3rd " 	498	2320	" " "
" " 	497	2200	" " "
" " 	426	1320	Poor stand

Tepary beans were planted on 30th December and 2nd February, the yields being 990 and 810 lbs. per acre respectively. The earlier planting suffered from waterlogging after the February rains, at which time flowering was at its peak. The low yield was caused by bud shedding and premature ripening of the crop. Severe sheet erosion resulted from the rain on 6th February, shortly after the later field was planted, with a consequent reduction in stand and yield.

Tepary beans continue to appear to be a crop well suited for rotation with cotton.

Groundnuts planted on 1st February gave yields of 1,000-1,130 lbs. of unshelled nuts per acre. The March drought came at the critical time when pegging was in progress, and this resulted in a reduced yield. Under the conditions, however, the crop is considered satisfactory.

Dolichos beans were planted this season for the first time in the Magut area, more for observations on their behaviour as an alternative host for American bollworm than as an economic crop. The field was sown in December. Flowering did not commence until late in April, and coincided with the usual autumn flight of cantharides beetle, to which the Dolichos flowers proved very attractive and on which they were easily found. Only a small crop of beans was harvested.

PESTS AND DISEASES.

As in previous years the programme of work was arranged to supply information required by the Insect Pest Control Section at Barberton.

Pongola Valley.—The outline of the work that is being carried out on the two Pongola sub-stations was given in the 1936-37 Report.

Plot 1.—The main planting (7 acres) was successfully made on 27th January without the use of irrigation. This was followed a fortnight later by a subsidiary planting ($\frac{3}{4}$ acre), the two forming part of a series of plantings, from the end of January to the end of March, for observation on growth behaviour and incidence of pest attack. The later plantings were made at Plot II, situated 14 miles

away in order that pest multiplication on earlier plantings should not confuse pest population counts on plantings made later.

Very rapid growth and development of fruit was made by the first planting during February, March and April. Towards the end of March, when drought conditions began to become manifest, an irrigation of approximately four inches was given.

Apart from extremely rapid development, the plants behaved in what is otherwise considered to be a perfectly normal fashion. 1,181 lbs. per acre of seed cotton of good quality and colour were picked by the end of August, plants being cut out and burned in September.

The subsidiary planting made on 14th February gave only 650 lbs. of seed cotton per acre.

Records of stainer infestation in the neighbouring bush, where the various wild host plants are found in great abundance, were continued, as were records of invasion of and breeding in cotton. The following are extracts from a summary of the stainer position made by Pearson :—"The infestation of cotton was heavy, late in time of season but early in respect of the crop, and extremely prolonged. The succeeding F_1 generation did not start maturing until eleven weeks after the initial immigration started, and was surprisingly small." This state of affairs he shows to have been due to the comparative attractiveness of the cotton crop relative to attractiveness of the wild host plants in the neighbourhood. "The most extraordinary thing of all is that in spite of this infestation the damage was so comparatively slight, and actually declined as the season advanced, the stainer population over the same period having been rising steadily." This is explained by the rapid increase in the ratio of green bolls to stainer in the early part of the period, and by open bolls offering the more attractive food after mid-June.

The position with regard to red bollworm is considered to be equally satisfactory. A steady but very low egg-laying was recorded in the cotton from mid-March to June, the total number per plant being but 2.6 eggs over this period.

Parsons' work on pupation periods shows that it is fairly certain that the red bollworm position cannot become aggravated during the course of many seasons of planting on this system.

Plot II.—A crop of 586 lbs. of seed cotton per acre, excellent in quality and colour, was picked during December and January from a planting made on 20th April, the growth progress of which was reported last year. A heavy infestation of *Dysdercus intermedius* and *D. nigrofasciatus* was noted, commencing early in December. Cotton bushes were removed at the end of January while still carrying

large numbers of green bolls, which, however, were mainly badly infected with internal boll disease.

It was mentioned in the previous Report that the plant "scaffold" resulting from a planting as late as 20th April was not sufficiently large to allow of an immediate fruiting response to watering in spring. Plantings were therefore made earlier in the season now under review. The main planting of 6 acres was made on 15th March, with subsidiary plantings a fortnight before and after this date.

It early became apparent that the 1st March planting would mature a considerable quantity of fruit during the winter, and offer ideal carry-over conditions for stainer and red bollworm; this planting was accordingly removed in May.

The main planting was carrying a few green bolls per plant in June. Cold weather and an attack of aphid caused a cessation in plant growth until late in July, when a good flush of squares followed an irrigation and two inches of rain.

At the time of writing (November) plants have reached a height of 28"-30", are carrying a few open bolls (the result of the June flowering) and very numerous but small green bolls. Migrant *D. nigrofasciatus* is present but not in quantity, and no stainer broods are yet to be seen. Red bollworm damage is non-existent, but considerable loss has occurred during early spring from spiny bollworm attack.

The subsidiary planting made on 31st March is carrying an occasional open boll. It has made almost the same style of plant otherwise, with about the same quantity of green boll, but looks fresher.

Variety-spacing Experiment.—An experiment involving three varieties of cotton at three spacings (*i.e.*, nine treatments), with the object of determining the influence of spacing or variety on pest incidence was concluded. To permit of the statistical analysis of infestation counts the layout was made on the randomized block basis.

Observations included bi-weekly egg counts of American and red bollworms, and counts of stainer, with an estimate of stainer damage in bolls at various dates and stages of maturity. As an indication of the relative stages of crop development, flowering curves were kept for each treatment.

The counts taken are primarily for the information of the Plant Breeding Section at Barberton, and have been sent there for consideration. The figures have indicated that experimental modifications are necessary in certain directions. These will be incorporated in the variety-spacing experiment to be conducted in the coming season.

Hand Collection of Damaged Squares.—An experiment was carried out for comparing the effects of (a) allowing bollworm attack to run its usual course; (b) the hand collection, bi-weekly, of damaged squares and any easily seen larvæ from the plants and the ground.

The hand collection plots gave an increased yield of 106 lbs. of seed-cotton per acre ($P = .04$) over the 1,114 lbs. per acre given by the untreated plots.

EXPERIMENT STATION, MAGUT, NATAL.

RAINFALL TABLE, 1937-38.

								Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1	...	...	...	...	...	...	...	.02	—	.56	—	.08	.05	.01
2	...	...	...	...	...	...	...	—	—	—	—	—	—	1.72
3	...	...	...	...	...	...	...	—	—	—	—	—	—	.58
4	...	...	...	...	...	...	...	—	.28	—	—	—	—	.57
5	...	...	...	...	...	...	...	.09	—	—	.01	—	—	—
6	...	...	...	...	...	...	...	.13	.20	—	—	2.19	.16	—
7	...	...	...	...	...	...	...	1.04	.10	—	—	—	—	—
8	...	...	...	...	...	...	...	—	—	—	—	—	.24	.20
9	...	...	...	...	...	...	...	—	—	—	—	—	.02	—
10	...	...	...	...	...	...	...	—	—	—	—	1.61	—	—
11	...	...	...	...	...	...	...	—	—	—	—	—	—	—
12	...	...	...	...	...	...	...	—	—	—	—	—	—	—
13	...	...	...	...	...	...	...	—	—	.07	.08	—	—	—
14	...	...	...	...	...	...	...	—	.10	.07	—	1.07	—	—
15	...	...	...	...	...	...	...	—	—	.25	.01	—	—	—
16	...	...	...	...	...	...	...	—	—	.05	.04	—	—	—
17	...	...	...	...	...	...	...	—	—	.05	—	—	—	—
18	...	...	...	...	...	...	...	—	—	—	—	.03	.60	—
19	...	...	...	...	...	...	...	—	—	.02	—	—	—	—
20	...	...	...	...	...	...	...	—	—	.90	—	—	—	.01
21	...	...	...	...	...	...	...	—	.02	.06	—	.24	—	—
22	...	...	...	...	...	...	...	—	.35	—	—	—	—	.41
23	...	...	...	...	...	...	...	—	—	1.67	—	—	—	.08
24	...	...	...	...	...	...	...	—	.05	1.13	.01	—	—	—
25	...	...	...	...	...	...	...	—	—	.26	.34	—	—	—
26	...	...	...	...	...	...	...	—	—	.20	—	—	—	—
27	...	...	...	...	...	...	...	—	—	.06	—	—	—	.03
28	...	...	...	...	...	...	...	—	—	.03	—	—	—	—
29	...	...	...	...	...	...	...	—	—	—	.66	—	—	—
30	...	...	...	...	...	...	...	—	—	—	1.20	—	—	—
31	...	...	...	...	...	...	...	—	—	—	—	—	—	—
								1.28	1.10	5.38	2.35	5.22	1.07	3.61

Total for year, 20.01 inches.

SWAZILAND
COTTON EXPERIMENT STATIONS, BREMERSDORP
AND CROYDON.
PROGRESS REPORT FOR THE SEASON 1937-38.

BY

J. V. LOCHRIE.

SEASON AND GENERAL.

Bremersdorp.—The total rainfall for the period September 1st to June 30th was high (34·83"), but poorly distributed. The season was not particularly favourable to cotton as the long dry period from October 8th delayed planting until the end of November. The best crops in the Station area are obtained when planting has been possible in late October or early November as, owing to the general fall in temperatures from April onwards and damage by stainer-carried bollrots as the season proceeds, the final crop depends on the flowers produced before the end of March.

In the country generally little cotton was planted on account of the low prices and, especially in the native areas, the late planting rains.

The chief features of the season were : (a) excellent conditions for ploughing during September and early October ; (b) the long dry spell until November 23rd, which made planting late ; (c) excessive rain, cloudiness and low temperatures during December and early January which slowed up the crop and hindered cultivation ; (d) the good conditions in February and March accompanied by very slight bollworm losses ; and (e) the poor finish of the crop due to low temperatures and to attack of stainers.

The Station cotton was planted in excellent conditions by the end of November, and full stands were obtained. Subsequent growth was good, but the prevalence of wet and cloudy weather markedly delayed flowering. From mid-February until the end of March the weather was hot and relatively dry, and the crop came on well. Despite the lateness of planting and the consequent short season the average yield of 260 lbs. lint per acre was reaped.

The crop was little affected by bollworm damage and the slight losses which did occur were due to red bollworm. Stainer did not appear until late in March—somewhat later than usual—but a considerable breeding up took place in the April rains and accounted for much of the late crop. On one section of the Station, where ordinary ginnery-delinted seed had been planted in late October, Angular Leaf

Spot and Blackarm spread rapidly in the wet conditions and the disease caused considerable loss of crop. In the main block of cotton, planted a month later and with acid-delinted seed, little infection developed and the spread was checked by the drier conditions in February and March.

Croydon.—The climatic conditions were, on the whole, similar to those at Bremersdorp, but with generally higher temperatures. The crop was planted in excellent conditions in early November and the trials yielded 325 lbs. lint per acre. Little rain fell from February 20th until the end of March, and on the light, sandy soil the season was short.

Bollworm damage was slight and though stainers increased rapidly little loss was felt owing to the early ripening of the crop.

COTTON.

Selections.—As in previous years this work has been confined to the material from the crosses made by Dr. Harland. The numbers have been reduced to 21 lots, most of which are from the (U.4 × Cambodia) × U.4 strains. The latter are like the U.4 lots in growth and habit and somewhat similar as regards earliness. The ginning percentages are satisfactory, but the lint length of some is rather below the standard of the U.4 strains. The most promising were grown in trials this season along with some U.4 strains. A severe wind storm damaged the stands and plants and no valid conclusions can be drawn from the yield figures. However, the comparison of these and the U.4 strains in the field showed up some promising good fruiting strains, and further trials will be made in the coming season. No jassid damage has been apparent on the Station in the past two seasons on any of the cottons. Whether this has been entirely due to season will be determined by the interplanting of known susceptible material in the selection block.

Variety Trials.—Trials were planted at Bremersdorp and Croydon of U.4 strains from Barberton.

At Bremersdorp the trials were planted in late November and stands and early growth were good. As stated above, this time of planting is late for the area.

Trial 1 comprised a large number of re-selections from 045 and the strain 052 which is now in fairly general cultivation. In the Barberton report for last season reference was made to the good cropping of 052 and to the fact that its ginning percentage is lower

than most of the early strains. In this season's trial at Bremersdorp eleven of the re-selections gave significantly higher yields than 052 and in practically all cases a higher ginning percentage. The figures below show the performance of the leading strains.

<i>Strain.</i>	<i>Lint, lbs. per acre.</i>	<i>Ginning percentage.</i>
052	229	34.6
052 5143	290	36.4
052 5143-6128	310	36.3
052 5143-6130	322	35.7
052 5146-6135	300	34.5
052 5147-6138	270	37.2
052 5149	273	37.8
052 6168	277	37.0

The difference required for significance at $P=0.1$ is 36 lbs.

Trial 2, consisting of late strains, mainly derived from 920 and 921, showed no appreciable differences in yield.

Trial 3 included 5149 and 5143 in addition to the main parent strains. The yields in this trial averaged 290 lbs. lint per acre and, here again, 5143 and 5149 were significantly higher yielding than 052.

This trial was duplicated at Croydon, the highest yielding strains being 5143, 5149 and 052. The relative yields of these strains at the two Stations are given below.

<i>Strain.</i>	<i>Yield in lbs. lint per acre.</i>	
	<i>Bremersdorp.</i>	<i>Croydon.</i>
5143	308	377
5149	301	337
052	278	345

In addition to the success in yield of the re-selections from 052 a striking feature at Bremersdorp in the later part of the season was the general robust appearance and "leaf holding" of strains 6130, 6128, 6135, 5143 and 5149. It was mentioned earlier that the later formed bolls did not open on account of the low temperatures and of stainer attack; but for these factors the yield superiority of these strains would have been greater.

Spacing.—Spacing experiments at Bremersdorp have been reported in previous years and the results showed that the most suitable spacing in general was 12" to 18" apart in 3' rows. On the light soil at Croydon the best results were given by a spacing of 18" in 3' rows; higher densities of plants gave no increase, while with fewer plants per acre the yield fell off.

Seed Disinfection.—In the 1936–37 season some damage by Blackarm and bacterial bollrot was noted on cotton on the Station and in farm blocks and reference was made earlier in this report to a fairly severe infection on an area of early planted cotton on the Station. An experiment was designed to test the effect of various seed disinfectants in controlling the disease. Mechanically delinted seed from the previous season's crop was used, and the layout was of the randomised block type with eight replicates. The treatments included a number of proprietary mercurial dusts, a "wet" mercury preparation (M.12), sulphuric acid and copper salts.

The results showed a markedly reduced primary infection where the seed had been treated with sulphuric acid, M.12 and, to a slightly lesser degree, with the mercurial dusts compared with untreated seed.

Sulphuric acid treatment increased the rate of germination, but not the total number of seedlings produced, while the mercurial dusts were not significantly different to the untreated seed, either in rate of germination or in total seedlings. The copper salts slowed up germination as did M.12.

Dry matter weights of seedlings showed a trend that was to be expected from the rate of germination figures.

ROTATION CROPS.

The season was not very satisfactory for the rotation crops. The wet weather made weeding difficult and the area suffered a heavy infestation of maize stalk borer. Heavy storms of wind and rain occurred during the season and, besides aggravating the stalk borer damage, these storms affected the maize pollination in certain blocks.

Maize.—Selection work on this crop is confined to the white flint types as these have shown themselves suitable to the conditions, particularly in the cotton-growing areas. The need, especially in the native areas, is for a maize type which will stand up to conditions of drought, and often low fertility, better than the commonly grown late dent varieties, and which will, in addition, be acceptable to the native as food and be readily marketable when any surplus is available.

Last season it was noted that the very early maturing white flint strains were thin stemmed and inclined to lodge. This weakness was emphasised this season as in the heavy wind and rain storms these strains collapsed badly. Previously it had been considered that the early ripening of these lots—despite their lower yields—would make them valuable for planting as a source of early food supply or as catch crops where main crop maize had failed. None of the selections that were made showed any useful improvement in resistance to lodging

and they can be safely discarded. This point of earliness is of importance in the native areas and fresh material for selection is being sought.

The stronger, medium early, strains are showing up promisingly, and the first lots are being issued in increasing amount to growers.

Strain trials were carried out at both Stations, with the late maturing dent variety—Hickory King—included for comparison. At Bremersdorp, under conditions of high rainfall and fair soil fertility, the late dent variety gave the highest yield, as expected—14 bags per acre against 12 from the two best flints. At Croydon, which is more representative of the areas for which the flints are intended, all the flint strains yielded higher than Hickory King, the range of variation being 9 bags from C.1 to 6 bags from Hickory King.

Fertilizer Effect.—On the light soil at Croydon the experiment this season showed increases in yield of maize from applications of 200 lbs. superphosphate per acre. As in previous seasons' trials, 3 tons kraal manure per acre gave substantial yield increases over unmanured plots.

Kaffircorn.—Reference was made in last season's report to the prejudice amongst natives against white seeded kaffircorn. This prejudice limited the spread of the original early dwarf strains produced, despite their high agricultural value. The present selection work is being carried out mainly on material from crosses between the white seeded dwarf type and a later maturing red seeded native lot. Trials at Bremersdorp and Croydon during the past two seasons show that several of the short, red seeded strains resulting from the crossing are as high yielding as the white parent. The first issues of these red strains has led to a heavy demand for seed among European and native growers.

Yields in the trials at Bremersdorp were low compared with last year, due to a heavy stalk borer attack, but at Croydon the crop did well. The short white strains averaged 2,250 lbs. per acre, the short reds, 2,150 lbs., and the best of the local varieties, 1,100 lbs.

Groundnuts.—Strain trials were continued at both Stations. Conditions at Bremersdorp on the heavier land were not very satisfactory and the average yield of 1,200 lbs. unshelled nuts per acre is below the average for the Station. Heavy rains tended to pack the land, and the long dry spell in March prevented the setting of the late flowers.

On the lighter soil at Croydon the average yield was 1,600 lbs. per acre, but, here again, there were no significant yield differences between strains.

During the past two seasons no yield increases of importance have resulted from further selection. The strains have yielded well in the various conditions in which trials have been conducted, and it is felt that further yield improvement is more likely to follow investigations on means of planting and handling the crop. The present strains have been bulked and issued to growers and a considerable increase in the acreage of groundnuts, particularly among natives, is taking place.

Results from earthing up the crop as against "flat" cultivation did not afford any conclusive results and the investigation will be continued.

As usual, odd plants with Rosette disease appeared at both Stations, but no appreciable amount of disease is reported from any area.

Miscellaneous Crops.—Small areas of a range of minor crops were grown to maintain seed stocks and for issues of seed. These included soya beans—both grain and forage types—tepany beans and cassava. A large quantity of cuttings of the latter is distributed each season.

SOUTHERN RHODESIA
COTTON STATION, GATOOMA.
PROGRESS REPORT FOR THE SEASON 1937-38.

BY
 J. E. PEAT AND A. N. PRENTICE.

GENERAL.

In spite of the season having been climatically one of the most difficult since the Station started, it has been, from the point of view of crop results, one of the most interesting and successful. Planting rains were very late and there was a very serious drought from the end of January till early in April—a critical period in the making of the crop. The fact that very satisfactory yields were obtained in such a season is due mainly to three factors: (a) the use of compost; (b) the hardy, better-yielding U.4 strains now being grown; and (c) the light insect attack.

Strains and selections were grown on two soil types on the Station. On the poorer soil, yields of the better strains ranged around 600–700 lb. seed cotton per acre. On the better soil type, which received a shower or two more than the other area, yields on the composted portion ranged around 1,000 lb. seed cotton per acre. The mean yield for the Station was 638 lb. seed cotton per acre over 61 acres, the total cotton acreage mean including wide spaced lots, poor yielding strains, and discard lots. The fact that heavier yields followed compost dressings is of very great importance.

Throughout the country it has been a season of comparatively mild insect attack. Bollworm damage was less than in many years, and stainer damage was light. A high proportion of the commercial cotton ginned at Bindura was free from staining and of good quality. 83% had a staple of $1\frac{1}{8}$ " and over, contrasted with 54% in 1936–37; and 83% was good colour, contrasted with 39% in 1936–37. The total output unfortunately is still small. Although expansion is slow, there is increasing interest in native cotton, and on the whole the yields that are being obtained are satisfactory. The main drawback to more rapid expansion, both European and native, is the distressingly low price of cotton. Native recorders from Gatooma are being used for extension work in the Native Reserves, where cotton is now being grown. It will be possible through them to collect more information on cropping and insect attack in these areas.

SEASON.

On the Station the rainfall was 19.14". Planting rains were very late, the first good rain falling on the 9th December. In parts of the country the January rainfall was excessive, slowing down growth and hindering cleaning operations. But this was not so at Gatooma. Plants made good growth until, towards the end of February, the drought began to affect them. During February and March only 1.88" of rain fell. There were two fair showers in the last week in February, but March was to all intents and purposes rainless (0.2"). The showers at the beginning of April amounted to only just over 1". Speaking generally, Southern Rhodesia south of Gatooma suffered as severely as or more severely than the Station, but much of the farming area to the north received better rains during February and March. The crop ripened for one picking, starting at the end of May. Winter temperatures were relatively high.

BREEDING WORK.

In spite of the season having been a very difficult one, the cotton cropping was satisfactory.

It has been a good year for testing strains. Again the best U.4/64 lots have been outstanding. In grouping and selection an arbitrary standard of plant hairiness was used: only material up to this standard was retained, whatever might be its other qualities. Selection and grouping were then made for cropping, finishing, and opening, and finally for ginning qualities and lint.

G.5,123 and G.5,79, the commercial strains grown throughout the country, though good yielders, are not in the first class for jassid resistance: further, under commercial ginning conditions, they give an outturn of only 31-32 per cent.

Four of the best 1937 lots, 7L1, 7L3, 7L5 and 7L31, are to be bulked at Gatooma, and three are being issued to a number of growers for a test multiplication. Three were selections from G.5,123, and one from G.5,30—the parent strain of G.5,123. Under the conditions of the year they made a very satisfactory showing. On the poorer soil they yielded around 600-700 lb. seed cotton to the acre, and on the better soil around 1,000 lb. seed cotton to the acre. They are good for plant hairiness, and have a higher ginning percentage than the present commercial stocks. They will be tested in trials this coming season.

A number of the 1937 single plant selections also show high promise. Thirteen of these will be grown in multiplication lots. Only one (ex Harland's AFC 26) is not ex a U.4/64 family. There are some 209 new single plant selections.

It is now almost certain that from within the segregating U.4/64 material a strain or strains will be obtained retaining the good qualities of the best U.4/64 families, cropping, good opening, and hardiness, but with a high measure of jassid resistance, higher ginning percentage and better lint.

A range of distinctive habits, types of opening, and types of crop finish showed up in the multiplication and single plant lots. A reference collection of some of the more interesting of these will be grown this coming season.

A number of Gatooma backcross lots (predominantly U.4/64 strains crossed with Cambodia, and backcrossed to the U.4 parent) were grown on. From the best special bulks were taken. It is interesting that at this stage in none of these did material show up which was as promising as the best of the U.4/64 segregates. Special bulks were taken in the 1937 back-cross material, and further backcrosses were made. In the latest of these Trought's Punjab American (513) has been used as the non-U.4 parent.

Harland's AFC 6, 15, 26 and 38, and selections from these were again grown. Their response was fair, but not as good as the better U.4/64 lots, and the general level of jassid resistance was not high.

Of the several Barberton strains grown in the last year or two, none, under Gatooma conditions, has been altogether happy. This past season 052, and two substrains, 5,143 and 5,149, were grown. These were striking in the early part of the season, and grew out better than the Gatooma material around, possibly too well for a droughty season: they were "sticky" in their finish, and appeared unhappy in their final cropping. They yielded better than their appearance had indicated, but lower than the U.4/64 material around. A Uganda selection of promising habit there, BP.50, was grown, but was not happy in its style of growth nor in its cropping.

CULTURAL WORK.

The fact that most of the cotton—and all of the cotton on the poorer soil (except controls in a compost trial)—was grown with a dressing of compost had much to do with the satisfactory yields obtained in spite of the poor season. The results from a combined compost and spacing trial on the poorer soil type are set out below:

COMPOST TRIAL 1937-38. STRAIN G.5,123. AREA 4.5 ACRES.

Quantity of Compost. Tons per acre.										Yield: Seed Cotton. lb. per acre.
0 tons	...	...	...	...	...	...	...	...	...	418 lb.
5 tons	...	...	...	...	...	...	...	...	...	595 lb.
10 tons	...	...	...	...	...	...	...	...	...	661 lb.

Difference required for significance ($P = .05$) = 74.

COMPOST AND SPACING TRIAL 1937-38. STRAIN G.5,123. AREA 3 ACRES.

Quantity of Compost. Tons per acre.				Spacing. Intra Row.	Yield : Seed Cotton. lb. per acre.
0 tons	...	...	...	6"	527
				1'	490
				2'	362
5 tons	...	...	...	6"	689
				1'	615
				2'	504
10 tons	...	...	...	6"	747
				1'	696
				2'	566

Difference required for significance ($P = .05$) = 86.

The spacing results show the importance of close spacing when the land is fairly poor and the season droughty. With better land a wider spacing is permissible. The composted plots grew out better than the non-composted, the 10 tons an acre plots quite appreciably better than the 5 tons an acre plots. Flowering started just before the middle of February and reached in mid-March at the closer spacing in the composted plots a peak of just over 1.5 flowers per foot per day. The flowering rate rapidly declined in the following two weeks. The earlier flowering of composted cotton will be important in years of heavier American bollworm attack. The crop was made, as it usually is, from the early flowering : 80 per cent. of the bolls made were from the flowering of the first three weeks. Flowering after mid-March contributed almost nothing to the crop. As was to be expected, in the shedding which took place "sheds" up to early March were predominantly bollworm punctured, but after about the third week of March the loss was predominantly caused by the drought. The boll maturation period this year remained remarkably steady—around 62-64 days from flowering to boll split.

Nearly 400 tons of compost have been applied for this coming season. The value of compost is considered so important that at Gatooma considerable attention is devoted to its preparation and application. As part of the scheme, and in order to obtain additional quantities of urine and dung, 55 bullocks were fattened this season, 40 for export as chillers to Smithfield market. The undertaking has been quite a profitable one. In such a scheme there is economic use of crop wastes and surplus cotton seed. For this country, cotton seed is one of the most valuable, and one of the cheapest, protein supplements.

Two further compost trials have been laid out, testing different rates of application, and a compost of poorer breakdown made by using smaller quantities of earth than the standard.

Maize suffered seriously as a result of the drought and yields were

low. The average for the Station was 6.2 bags per acre (bag=205 lb.), higher than the yields in the district, mainly because much of the maize was following cotton in the rotation. Little difference could be observed between maize following composted and non-composted cotton.

With the co-operation of Mr. J. Trinder, a fertiliser trial was carried out on very poor sand-veld in the Nyamandhlovu area near Bulawayo. It was a very poor season there, especially on such land, but the results in the table below show a marked increase in yield following an application of superphosphate, plus a top dressing of nitrate of soda at thinning time.

FERTILISER TRIAL 1937-38. COMPENSATION FARM, NYAMANDHLOVU. AREA=2.2 ACRES.

Fertiliser. lb. per acre.								Yield: Seed Cotton. lb. per acre.	
Superphosphate.	200 lb.	...	...	...	...	...	...	129 lb.	
Sulphate of Potash.	200 lb.	...	...	...	...	...	...	176 lb.	
Nitrate of Soda.	200 lb.	...	...	...	...	...	...	383 lb.	
Superphosphate.	200 lb.	...	...	...	...	...	...	671 lb.	
Superphosphate.	200 lb.	plus Nitrate of Soda.	200 lb.	...	...	...	...	671 lb.	
No fertiliser	...	...	...	...	...	...	...	165 lb.	

Difference required for significance ($P = .05$) = 152.

A similar experiment will be conducted this year at the Tobacco Research Station at Trelawney, also under sand-veld conditions. Compost will also be tried under these conditions.

INSECT WORK.

As has been mentioned, throughout the country it has been a season of comparatively mild insect attack. Jassid might be described as moderate. American bollworm damage was less than in many years. Stainer damage was light. This is reflected in the high proportion of clean white cotton passing through the Bindura Ginnery. Aphis was troublesome during the drought period in February-March.

Jassid.—At Gatooma it was a year of moderate jassid attack. Bancroft and the less resistant U.4 strains suffered in proportion to their lack of resistance. Improved Bancroft in the museum block, probably slightly more hairy than the old commercial Improved Bancroft, yielded at the rate of 230 lb. seed cotton to the acre. The less resistant U.4 lots showed an interesting lack of finish of the upper crop contrasted with the more highly resistant strains, and this was reflected in the character of the lint from the later bolls. In areas, bulk G.5,123 and G.5,79 showed slight jassid damage. The results of the year emphasise the importance of high jassid resistance, even in a year of moderate jassid attack such as the present. A demonstration block of jassid-resistant and susceptible strains is to be planted to illustrate the various degrees of damage suffered with differing degrees of resistance.

American Bollworm.—There was scattered American bollworm egg-laying in cotton in January and early February. Egg-laying, though low, started more seriously in the second week in February, just before the beginning of flowering, about 1,500–3,000 eggs per acre per day. Early in March it reached a peak of around 1·5 eggs per plant, just over 20,000 eggs per acre per day. The main period of larval attack was in March. At the peak period of attack there was about one 1st instar larva to every two plants; one 6th instar larva to every five plants.

The maize plantings (108 acres) on the whole reached the tasselling stage, in which they are most attractive to bollworm, early in March, about the time that the heaviest egg-laying was occurring on cotton (61 acres). The egg-laying on maize was comparatively low, the peak being around 3,000 to 4,000 eggs per acre per day. In general the egg-laying did not amount to more than about a quarter of that which was taking place on cotton at the same time.

Rhodesian *Dolichos* (31 acres), planted immediately after the cotton, attracted egg-laying for more than a month previous to the start of its budding in the last week in February. Egg-laying early in February was variable, about 5,000–6,000 eggs per acre per day, but reached as high a figure as 16,000 eggs per acre per day. The crop became more attractive in the period from the start of budding to the first flowering stage. Towards the end of March egg-laying rose to a peak soon after the majority of plants were in flower, up to about 36,000 eggs per acre per day. The intensity of egg-laying was much lower than for the last two years.

A small area (0·8 acre) was planted with seed of a type of *Dolichos* (Poona Lubia) obtained from the Sudan. It came into flower considerably earlier than the Rhodesian *Dolichos*. Plants were at the full budding, first flower, stage at the beginning of February. Egg-laying figures early in February varied around 4,000–9,000 eggs per acre per day, no more than on Rhodesian *Dolichos*, which, however, was not then even budding.

When cotton was at its most attractive stage, towards the end of February and early in March, it was attracting egg-laying as heavy as, or even slightly heavier than, the egg-laying taking place at the time on Rhodesian *Dolichos*: but when the Rhodesian *Dolichos* came into full attraction after the middle of March, egg-laying then became very much heavier on it than on cotton; but by this time the rate of cotton flowering was declining rapidly. Rhodesian *Dolichos* comes into its most attractive state, the first flowering stage, about a month or so too late to be of maximum value as a trap helping cotton. The

Sudan Dolichos, though considerably earlier in flowering, has not sufficient attraction for use as a trap. What is wanted is an earlier Dolichos, similar to the Rhodesian type, but more attractive than the Sudan type. In the Rhodesian Dolichos crop a number of selections were made for earlier flowering. A range of Dolichos types is being obtained through the London office.

Work will be continued to see whether the first eggs laid on the first maize crops give rise to a flight of moths that lay eggs on cotton later. It seems possible that much of the early egg-laying, owing to the nature of the food supply, does not give rise to a proper moth population. This past season the first 5th-6th instar larvæ on maize were found in the second week in March, from eggs laid about the third week in February. This would be too late to affect egg-laying on cotton, but could affect later egg-laying on Dolichos. Early egg-laying on maize, however, though low, had been taking place at the end of January-early February. An attempt will be made to find out what larval-moth survival there is from this first egg-laying. The intensity is low, but it is taking place over a wide acreage of maize and might thus affect the egg-laying position on cotton.

The first 5th-6th instar larvæ on Rhodesian Dolichos, from eggs laid probably about the middle of February, were observed in the first week in March, again too late to affect egg-laying on cotton. But egg-laying had been taking place at the end of January and early in February. An attempt will be made to find out the larval-moth survival from this early egg-laying.

The first 5th-6th instar larvæ on Sudan Dolichos, from eggs probably laid about the end of January, were found in mid-February. These larvæ were allowed to pupate; moths emerged during the period of heavy egg-laying on the field cotton.

On volunteer gram a large 5th-6th instar larval population was found at the end of January, developed from egg-laying probably early in January. The plants were destroyed, but moths from the larval population found on gram this season, could have emerged in time to contribute to the main egg-laying on cotton.

Thus, both early planted gram, and early maturing Dolichos could have bred up an American bollworm population later to attack cotton. This coming season they will be tried as traps for this early egg-laying.

During January and February an intensive search for larvæ was made on many weeds. Very few eggs, but no larvæ, were found on a number of weeds—pigweed, *Datura*, wild gooseberry, blackjacks.

From the end of March until mid-May, 5th and 6th instar larvæ were allowed to pupate in individual and mass emergence field cages.

The main emergences from the first larvæ introduced were in April–May, but from the later introductions moths emerged each month until mid-September. (Contrast the Sudan bollworm emergences from similar pupation experiments, starting with the first rains, in October–November, and with the peak emergence in December–January). At the time of the August–September American bollworm moth emergence veld trees were in bud and flowering. A search was made for eggs and larvæ on these trees, but without success.

Sudan Bollworm.—Fairly marked egg-laying occurred on one month old plants in January, agreeing with the main moth emergence period in the cages. From the records it is probable that the food then available on the young cotton plants was unsuitable for normal larval development. Egg-laying became less towards the end of January, and was at its lowest during February–March, around 300 eggs per acre per day. It increased about the end of March, and reached a peak in April, around 2,000 to 3,000 eggs per acre per day.

The Sudan bollworm moth emergence results, and the egg-laying figures on the field cotton again support the policy of prohibiting ratooning.

Stainers.—The first adult stainers were observed in the crop early in March—about two weeks after the start of flowering. Until mid-April adult populations were small, varying in different fields from between 300 to 1,000 adults per acre. In these primary populations *D. fasciatus*, *D. intermedius* and *D. supersticiosus* were present in approximately equal numbers. At the beginning of May adult populations of *D. fasciatus* started to increase markedly, up to 9,000 per acre in mid-May in one land, 3,000 in another. This increase had been expected from the records of the 5th instar nymphal populations early in May—up to 15,000 per acre in the one land, 6,000 per acre in the other. Adult populations of *D. intermedius* showed no marked increase during the season. At their highest they were just under 1,000 per acre. Early in June the 5th instar nymphal populations rose to as high as 5,000 per acre, but the highest adult population remained under 1,000 per acre. Adult and 5th instar nymphal populations of *D. supersticiosus* remained small throughout the season.

Staining was negligible. Early stainer populations were small, and the dry February and March must have been unfavourable to any spread of internal boll disease. The crop was mature, or nearly so, by the time the *D. fasciatus* populations increased in May. Throughout the country there were few reports of stainer damage, even from north of Salisbury, where there was fair rain in February and March.

The prevention of ratooning must have played a part in the production of the clean crop, even in this, a non-stainer year.

An experiment was laid down in order to attempt to correlate with plant habit and bad finishing, stainer populations and the puncturing and staining of the bolls. Results were inconclusive. Owing to the drought, plants did not grow out as well as in the previous year. The early stainer populations were small, and staining was negligible.

Areas of cotton were trapped with cotton seed traps. On balance there seemed to be a small advantage gained from the trapping. Towards the end of the season marked results were obtained in the trapping of nymphs on various crushed cotton seed traps. Experiments with these will be continued.

NORTHERN RHODESIA.

PROGRESS REPORT ON THE COTTON WORK FOR THE SEASON 1937-38.

BY

A. G. BEBBINGTON (*Empire Cotton Growing Corporation*) AND W. ALLAN
(*Northern Rhodesia Department of Agriculture*).

SEASON.

The rains were again early as in the previous season, and planting was generally earlier than usual. Good rains fell in December and January, but the fall during the remainder of the season was very light. As a result, maize and groundnut crops in the areas adjacent to the railway line suffered, while considerable shedding of crop was caused in cotton on the lighter soils.

The season was characterised by an extremely low attack of *Dysdercus supersticiosus* and a comparatively low attack of *D. fasciatus*.

American Bollworm (*Chloridea obsoleta*) only caused serious damage in a few cases.

EXPERIMENTS.

At Mazabuka work was restricted to stainer and flowering records on a two-acre bulk plot, together with the usual records on wild host plants of stainer.

The main investigations have been transferred to a sub-station situated in the area of which the soil was described in last year's report as "The Southern transitional type, varying from good loams to poor sands." This Station is at an altitude of between 3,800 and 4,000 feet.

Two sets of observation plots were planted; that on the Station gave no indications of any value on account of excessive soil variations. The second set, consisting of 27 different strains of U.4, from Barberton, Gatooma and Domira Bay, was planted on a neighbouring farm on land very typical of a large part of the adjoining native reserve. The plots were planted in duplicate and covered big soil differences, the average yield in Series I being 314 lbs. seed cotton per acre, while that in Series II reached 518 lbs. seed cotton per acre.

Flowering records, boll maturation periods, shedding and stainer counts were made on all plots. The main results from these plots may be summarised as follows:—

- (1) The yields themselves are of value as a comparison with those from adjacent native gardens, where the average dropped to

only 120 lbs. of seed cotton per acre, due to the use of old land and poor cultivation.

- (2) The flowering records, when compared with those from Mazabuka, show very plainly the drop in flowering rate due to altitude and the generally poorer soil type. This point is of first importance when considering the effect of a stainer and bollworm attack in an area such as this.
- (3) Considerable differences between strains were shown. The Gatooma strains almost all gave high yields while their good opening quality was very marked.

A further trial of the same strains was carried out on the transitional soils of the Northern plateau. This gave no information of value owing to a severe attack of American Bollworm (*Chloridea obsoleta*).

COTTON IN NATIVE AREAS.

Considerable improvement in yield was shown in all areas this season. This was partly due to better cultivation and better land, but also to the much lower attack of *D. fasciatus*.

Observations in native gardens in January and February showed a quite widespread infection of the young plants with a form of collar rot, which affected the plants to varying extent. In some cases the plants were killed off while in others they recovered, although growth was extremely slow. The disease appeared to be correlated to some extent with old and worn-out land, although, in some instances, it appeared on comparatively new land. This may be a factor of major importance in the plateau areas, where rapid growth is essential on account of stainer attack and the early onset of the cold season.

Preliminary trial plots were established in the lower Zambesi Valley during the season. Thirty-three natives put in gardens of varying size amounting in all to about 14 acres. The average yield was 272 lbs. seed cotton per acre, with a maximum yield of 628 lbs. per acre. The main factors in depressing yield were late planting (three-quarters of the plots were not planted until the end of December) and poor cultivation in some cases. Considerable further investigation is required before cotton-growing can be encouraged, on account of the possibility of heavy stainer attack (this is referred to below under the work on insect pests), and also on account of the rainfall, which is low and extremely variable.

The preliminary trials initiated by Mr. R. H. Fraser, of the Agricultural Department in the Luangwa Valley, were continued. Forty-five growers put in cotton over a total of about 27 acres. In spite of quite a heavy infestation of Red bollworm (*Diparopsis*

castanea) an average yield of 608 lbs. of seed cotton per acre was realised with a maximum of 1,200 lbs. per acre. The area appears to be well suited to cotton-growing, although strict adherence to general uprooting of the crop will be necessary to prevent increase in the bollworm population. Considerable progress has already been made in the uprooting of native Kidney cotton bushes. The position with regard to stainer requires further investigation.

INSECT WORK.

The detailed work on American bollworm (*Chloridea obsoleta*) has now been suspended, and records are being made on the three stainers *Dysdercus supersticiosus*, *D. fasciatus*, *D. intermedius* and their wild hosts. These records were carried out in all the areas outlined in last year's report, and, in addition, in the lower Zambesi Valley.

Dysdercus supersticiosus.—Previous records on the wild hosts of this species, together with observations in the insectory, had indicated that the species survived the cold season in small quantities only, mainly as nymphs, on account of a prolonged maturation period under low temperature conditions. In October, 1937, the first migration to *Triumfetta* spp. was observed, and this occurred in such quantity that a much larger survival through the winter period had to be considered.

No large population had ever been observed during the months of July, August and September. In consequence, a series of daily searches, by parties of native recorders, was carried out in the Southern transitional area during these months. The results showed that in areas where there was little destruction or disturbance of the hosts, *Hibiscus asper* and *H. cannabinus*, by cattle, there is quite a large survival of nymphs and some adults on these plants. While these records are of considerable importance, the problem of survival in other districts still remains. Similar searches in the Northern and Southern plateaux were made without result. In fact, in the Northern plateau district the recorders were unable to find a single specimen of the species from the end of July until its reappearance on *Triumfetta* in mid-October.

The species was found to occur in very large quantity on a number of *Hibiscus* spp. in the lower Zambesi Valley and a number of new *Hibiscus* hosts were found. The climatic conditions in this Valley are hot and dry and are generally favourable to the growth of *Hibiscus* as there is little grass competition.

An indication was obtained in March that a number of the *Hibiscus* spp. are very early maturing, and that this was leading to a migration

of *D. superstitiosus* to cotton at that time. Further investigation of the flowering and fruiting of the hosts is needed.

The position with regard to *D. superstitiosus* in the Luangwa Valley is somewhat different. The climatic conditions there are hot and humid, with the result that there is very considerable grass growth and a correspondingly small population of *Hibiscus* spp., except in the neighbourhood of the foothills. The records on wild hosts at present are poor and do not give information of much consequence.

Dysdercus fasciatus.—The records on this species have been continued in all areas, and, with the exception of the Zambesi and Luangwa Valleys, where they are not full enough for any conclusions to be drawn, they show remarkable uniformity in the effect of various factors on the major host plant, *Thespesia rogersii*, and its consequent effect on *D. fasciatus*.

This year's records are of interest when compared with the previous season. Last season the flowering of *T. rogersii* was exceptionally late and low, consequently an early release of stainers took place from the trees, which resulted in a very early and severe attack on cotton. This year the flowering was early and abundant. A heavy infestation of the trees by the larvae of a Cossid moth then took place with consequent partial destruction of the crop. This caused stainers to be driven from the trees, but at a later date and much slower rate than in the previous season. As a result, the damage caused by this species in cotton was very much less in all districts.

Red Bollworm (Diparopsis castanea).—A search for the wild host of this pest, *Cienfuegosia hildebrandtii*, was carried out in the lower Zambesi Valley, in March, but was unsuccessful, nor could the larva be found in cotton.

Cienfuegosia could not be found during a search in the Luangwa Valley in April, although large populations of the larvæ were found in cotton gardens and on native kidney cotton bushes. Further search in September and October established the presence of all stages of the larvæ on kidney cotton throughout the area.

ANGLO-EGYPTIAN SUDAN.

PROGRESS REPORT ON THE WORK ON COTTON CARRIED OUT BY THE PLANT BREEDING SECTION, AGRICULTURAL RESEARCH INSTITUTE, SEASON 1937-38.

BY

H. E. KING, R. L. KNIGHT AND R. R. ANSON.

GENERAL.

The programme of experiments for the season was carried through at all substations with, on the whole, satisfactory results. Yields at Shambat, however, were rather low, and at Kadugli poor rainfall made conditions difficult. "Outstation" varietal tests in various parts of the country were all successful.

CLIMATE, DISEASES AND PESTS.

The Gezira.—Total rainfall was slightly above normal; in April, May and July falls were abnormally heavy and in June, August and September below average. On the Research Farm, July was extremely wet, but fortunately a relatively dry August enabled the plots to be cleaned and sown to programme. Temperatures were exceptionally low in late November, high in February, abnormally low in March and very high in April.

Blackarm was never of more than minor importance; leaf-curl was slight on the farm, but was recorded in parts of the Gezira late in the season.

Pink bollworm damage to cotton was considerable and jassid damage occurred in the Northern Gezira.

Shambat.—Climatic conditions were not markedly abnormal. Rainfall was low in total quantity though individual light showers were numerous, commencing early and continuing late.

Blackarm caused appreciable damage to Egyptian cotton strains in September. Jassids were reported as causing very considerable injury in October, while aphid infestation was general in January. Pink bollworm damage commenced early, and although increasing rather slowly, reached a high figure by February. Leaf-curl was fairly general on susceptible cotton strains and severe on bamia.

Kadugli.—A prolonged dry spell occurred in June and July, and rains ended abruptly in early October. The total, which included

115 mms. falling in May (before the planting season) was only 554 mms.—an abnormally low figure.

White ants were very troublesome throughout the season. Flea-beetles were active during the dry spell, and leaf-rollers (*Sylepta derogata*), where not controlled by hand picking, did considerable damage in September. Bollworms and blackarm were not of major importance this season.

EXPERIMENTAL RESULTS.

Cotton Breeding Work—Egyptian Strain.—At the Gezira Research Farm growth was good, though somewhat irregular, and yields were satisfactory. Further progress was made in isolating improved subtypes of the more successful strains, in particular of X1530 (subtype N.T.17), of X1730, of N.T.2 (high quality Sakel) and of N.T.36 (an X04729 subtype). A bushy subtype (N.T.56) from N.T.2 origin was found to be breeding true for habit and promised to prove heavy yielding.

At Shambat the transference of blackarm resistance to Egyptian types by repeated backcrossing was successfully carried a further stage. Progenies of the composition $X1530 \times (X1530 \times (X1530 \times B.31))$ showed X1530 characters very strongly predominating, while plants possessing resistance to blackarm infection occurred within these progenies in numbers corresponding very closely to the proportions expected. Similar results were obtained with backcrosses involving N.T.2 strain, and further backcrossing on a large scale with both lines produced the necessary seed for sowing big progenies in the coming season.

Propagation of Egyptian Cotton.—Sufficient seed of various new strains was obtained for sowing varietal tests and further propagation areas. In particular some 43 ardebs* of N.T.2/36 were obtained from a 19 feddan* plot sown with only 60 rattles* of seed.

Yield Testing of Egyptian Strains of Cotton.—(i) *First Trial of Thirteen New Substrains in "Line Test" (Gezira).*—Germination and growth were poor and irregular on this plot making comparison of strains difficult. None was convincingly outstanding, but several gave results judged sufficiently promising to justify inclusion in larger scale trials in the coming season. N.T.56 was amongst the highest yielding, while X1730F, N.T.49 (a substrain from X1530) and N.T.36/37 also did well.

(ii) *Varietal Tests and Comparative Inspection Plots in the Gezira.*—Twelve types were tested in a replicated plot at the Research Farm. Six of these were also included in a varietal test plot at Barakat Seed

* 1 ardeb=270 rattles ; 1 rattle=0.99 lb. ; 1 feddan=1.038 acres.

Farm and four were grown, in addition, in a replicated plot at Hag Abdulla and in inspection plots at Wad Shair. Growth was satisfactory at all sites, except for a very big range in fertility across the Barakat plot.

The yields of the two major experiments are given in Appendix I.

The superiority of X1730A over Gash Sakel corresponded closely with previous experience, but N.T.3/34 failed to fulfil its promise of two seasons ago, while "Type 917" was not outstanding at any site this season.

Of the newer strains N.T.35/36 (a selection for better lint from the stock from which X1530 and X1730 arose), gave yields rather inferior to X1730A, but N.T.17/36 (a selection from X1530A for improved lint quality), gave at the Research Farm a final seed-cotton yield equal to X1730A, and was appreciably earlier cropping. N.T.2/36 gave a significant increase over Gash Sakel at the Farm and was superior to N.T.2/34 in seed-cotton yield and in ginning outturn. It also did well at Barakat and Hag Abdulla. The success of this strain, with its high quality lint of Sakel character, may be regarded as the outstanding feature of the tests.

American Cotton Breeding Work at Kadugli.—In spite of the unfavourable season, some useful progress was made in isolating types worthy of bulking for yield testing. These included substrains of "513," Lone Star, U.4, Durango, Trinidad Hybrid types and hybrids of Pump Scheme Strain with blackarm-resistant Uganda B.31. In addition, modifications in the technique to suit local conditions were worked out for employment in future seasons.

Propagation of American Types of Cotton.—Strains sown at Shambat yielded seed for varietal tests and further propagation plots. In particular, sufficient seed was produced for sewing roguing plots of 511D at Maridi and of 514E on a northern pump station.

Yield Testing of American Strains of Cotton.—(i) *Line Test, Kadugli.*—Results were moderately satisfactory. Three strains showed fairly marked superiority to Pump Scheme strain, namely, N.T.41 (a Lone Star derivative), N.T.43 and N.T.46 (Trinidad hybrids, N.T.46 being a successor to N.T.15). Results with other strains enabled their relative importance to be assessed. 511E yielded no better than control, but was considered worth trial as a successor to 511D in Equatoria.

(ii) *Standard Varietal Test Plots—Rain-grown.*—The results of the series of five standard varietal tests, two in Nuba Mountains and three in Equatoria, are given in Appendix II, together with yields from a further experiment at Opari.

The yields at Kadugli were high in spite of the poor rainfall, but the local conditions appear to have resulted in a remarkable levelling up in crop production amongst types of diverse origin and contrasting vegetative habit. At Talodi also seed-cotton yield differences were notably slight. N.T.15 (a hybrid type of U.4 $\times$ Cambodia origin) by reason of high ginning outturn gave the highest lint yields at both sites. 511D showed some improvement over 511C in ginning outturn.

High yields and useful results were obtained from Maridi and Opari in Equatoria, but at Kerripi yields were poor.

XA129 gave, at Maridi and Opari, a result strictly in accordance with the results of previous trials. The very big increase over control shown by 511C at Maridi is not supported by the results of Kerripi or Opari plots, but an additional plot at Opari, in which 511C was compared with Pump Scheme strain at two standards of cultivation, gave a similar percentage increase and, on the whole, last season's good results with this strain are fully confirmed. The results of the Cultivation Experiment at Opari (Appendix II) indicated that heavy weed competition tended to emphasise rather than obscure the superiority of 511C.

511D (in a first trial and at Maridi only) promises a further substantial increase in yield.

(iii) *Irrigated Varietal Test at Gureir, Northern Province.*—Stand and regularity of growth were satisfactory and yields high. The figures are given in Appendix III. Differences between strains in final lint yields are small, but the majority were rather earlier cropping than the control type. 513E held a very big lead indeed until late in the picking season. 514E, a re-selection from 514D (of Pump Scheme strain origin) did well, but 514D was disappointing this season, as also was XA1129.

GRADING AND SPINNING TESTS.

Samples of lint from the more promising strains were, as usual, submitted for spinning and grading tests, and acknowledgments are due to Messrs. Wolstenholme and Holland and to the British Cotton Industry Research Association for their courtesy in carrying out these tests.

Amongst the Egyptian types, samples of N.T.2 strain again gave outstanding results both in brokers' valuations and yarn strength. N.T.2/36 appeared to have inherited in full the good quality of earlier representatives of this strain, and very promising results were given by a sample of N.T.56/37, an "off type" substrain from N.T.2 with a distinct bushy habit of growth but (apparently) very similar lint

characters. X1730A was graded well, but failed to spin quite as well as Gash Sakel control. N.T.17 strains, which had promised improved lint quality compared to X1730A, did not do well, while N.T.35/36, though grading better, was a little inferior in yarn strength.

Of the American Upland strains grown under rainfall, 511C was graded rather higher than the control type (Pump Scheme Strain) as in previous seasons, but was only about equal in spinning qualities. 511D (a higher yielding substrain) appeared to be a trifle inferior to 511C in lint quality. XA129, as in many previous tests, was graded inferior to control, but spun as well and gave yarn of good appearance.

Durango from Kadugli again gave immature fibre of low hair weight, but spun almost as well as control.

Samples from American types grown under irrigation upheld the marked high quality of "514" strain. 514E substrain was priced lower than 514D, but spinning data showed no difference between them. 513E, a substrain from 513 selected for better quality, showed an increase in length, an improvement of 65 points in brokers' valuation, and a highest standard count figure nineteen units higher.

APPENDIX I.

Yield Data of Varietal Test Plots of Egyptian Strains in the Gezira.

Note.—Throughout these tables the seed-cotton yield is given in kantars of 315 rottles per feddan based on the nett area actually picked.

The column headed G.O.T.% shows the total lint yield as a percentage of the total seed-cotton yield (based on the actual ginning of the whole crop).

The lint yields are given firstly in rottles per feddan and secondly expressed as a percentage of the lint yield of the particular strain regarded as the control type.

G.R.F., Replicated Strip Test (12 × 6).

<i>Strain.</i>	<i>Seed-Cotton.</i>	<i>G.O.T.%</i>	<i>Lint.</i>	<i>Lint as % of Control.</i>
X1730A	5.77	35.9	646	130
N.T.17/36	5.79	35.0	632	127
N.T.35/36	5.64	35.5	624	126
N.T.36/36	5.21	36.1	587	118
N.T.2/36	5.40	33.7	567	114
N.T.18/35	5.43	33.3	563	114
N.T.3/34	5.67	31.4	555	112
N.T.2/34	5.23	32.9	536	108
N.T.16/35	4.85	34.0	515	104
"Type 917"	5.08	32.5	515	104
Gash Sakel (Control) ...	4.87	32.7	496	100
N.T.19/35	4.74	33.5	494	100
S.E.	—	—	± 22	± 4.4

At P=0.05 differences of 12 in the last column are significant.

APPENDIX I—*continued.**Barakat, Seed Farm Replicated Strip Test (6 × 5).*

Strain.	Seed-Cotton.	G.O.T.%	Lint.	Lint as % of Control.
X1730A	6.87	35.8	777	145
N.T.35/36	6.13	35.0	677	127
N.T.2/36	5.45	33.6	577	108
"Type 917"	5.24	32.4	535	100
Gash Sakel	5.17	32.8	535	100
N.T.3/34	5.15	31.0	504	94
S.E.	—	—	± 58.8	± 11.0

At P=0.05 differences of 32 in the last column are significant.

APPENDIX II.

Yields of Raingrown American Cotton Varietal Test Plots.

The note at the head of Appendix I applies to the figures in these tables also.

Kadugli, Nuba Mountains. Standard 5 × 5 Varietal Tests.

Strain.	Seed-Cotton.	G.O.T.%	Lint.	Lint as % of Control.
N.T.15/35	3.74	30.4	359	105
Ug. S.G.29	3.79	28.7	343	101
Pump Scheme (Control)...	3.82	28.3	341	100
511D	3.82	27.5	331	97
511C	3.87	26.8	327	96

In view of the very small differences between seed-cotton yields of varieties statistical analysis has not been carried out.

Talodi, Nuba Mountains. Standard 5 × 5 Varietal Test.

Strain.	Seed-Cotton.	G.O.T.%	Lint.	Lint as % of Control.
N.T.15/35	2.83	31.8	284	109
Pump Scheme (Control)...	2.84	29.1	260	100
Ug. S.G.29	2.73	29.0	249	96
511D	2.77	28.2	247	95
511C	2.66	27.2	228	88
S.E.	± 0.09	—	± 8.5	± 3.3

Varietal variance did not reach the 5% level of significance.

Maridi, Equatoria. Standard 5 × 5 Varietal Test.

Strain.	Seed-Cotton.*		G.O.T.% *	Lint. *	Lint as % of Control.*
	Total.				
511D	3.66	3.17	28.9	289	166
511C	3.37	2.86	28.4	256	147
XA129	2.86	2.26	29.1	208	119
Pump Scheme	2.45	1.99	27.8	175	100
N.T.14/36	2.25	1.52	27.4	131	75
S.E.	—	± 0.11	—	± 9.5	± 5.4

* These figures are on cotton picked up to the end of January only, the total yield includes pickings up to late March.

At P=0.05 differences of 16 in last column are significant

APPENDIX II—continued.

Kerripi, Equatoria. Standard 5 × 5 Varietal Test.

<i>Strain.</i>	<i>Seed-Cotton.</i>	<i>G.O.T.%</i>	<i>Lint.</i>	<i>Lint as % of Control.</i>
511C	1.87	27.0	159	105
N.T.15/35	1.75	29.1	160	105
N.T.14/36	1.69	29.5	157	103
XA129	1.66	29.7	155	102
Pump Scheme (Control)...	1.69	28.5	152	100
S.E.	± 0.06	—	± 5.4	± 3.5

Varietal variance did not reach the 5% level of significance.

Opari, Equatoria. Standard 5 × 5 Varietal Test.

<i>Strain.</i>	<i>Seed-Cotton.</i>	<i>G.O.T.%</i>	<i>Lint.</i>	<i>Lint as % of Control.</i>
XA129	2.34	30.3	223	119
N.T.14/36	2.13	29.7	200	106
511C	2.22	27.5	192	102
Pump Scheme (Control)...	2.06	28.9	188	100
N.T.15/35	2.00	29.0	183	97
S.E.	± 0.07	—	± 6.5	± 3.5

At P=0.05 differences of 10 in last column are significant.

Opari Cotton Cultivation Experiment (with two varieties).

<i>Treatment.</i>	<i>Seed-Cotton.</i>	<i>511C as % Pump Scheme Strain. (Seed Cotton).</i>		
511C Frequent Cleaning	2.24	160	130	511C. 136 Pump Scheme Strain 100 S.E. ± 5.8
Pump Scheme Strain	1.72	123	100	
" Normal Cleaning	1.40	100	—	
511C Minimum Cleaning	1.09	78	147	
Pump Scheme Strain	0.74	53	100	
S.E.	± 0.10	± 7.1	—	

Lint yields were not recorded for this experiment.

At P=0.05 differences of 21 on the third column are significant.

APPENDIX III.

*Yields of Irrigated American Cotton Varietal Test Plot.**At Gureir—Northern Province.*

The note at head of Appendix I gives the units used.

<i>Strain.</i>	<i>Seed-Cotton.</i>	<i>G.O.T.%</i>	<i>Lint.</i>	<i>Lint as % of Control.</i>
513E	9.13	25.7	733	112
514E	8.12	27.7	703	108
514F	7.61	27.7	658	101
Pump Scheme (Control)...	8.04	26.0	653	100
N.T.14/36	6.78	30.2	639	98
XA1129	6.93	29.2	633	97
514D	7.24	27.7	627	96
S.E.	± 0.30	—	± 25.8	± 3.9

At P=0.05 differences of 11 in the last column are significant.

[Included by courtesy of the Uganda Government.]

UGANDA

COTTON EXPERIMENT STATIONS, BUKALASA AND SERERE. PROGRESS REPORTS FOR THE SEASON 1937-38

BUKALASA ZONE.

BY

G. W. NYE.

SEASON.

Both acreage and production in Buganda showed substantial increases on those of the previous season. The increase in production, however, fell short of that in acreage, the yield per acre being a little lower than in the previous season. The total rainfall at Bukalasa was very little short of normal, but the distribution was bad. Dry spells occurred both in the early growing season and in the picking season. Grade was good, but there was little or no top crop and there was a drop of a millimeter in staple.

BREEDING WORK.

A large number of primary selections from the field was received, but very few of them displayed lint of satisfactory staple in the first progeny. Interest in the new selection series centred around the B.P. 50 and B.P. 52 families, the problem being to find resistance to Wilt in the B.P. 50 family and resistance to Blackarm in the B.P. 52 family. The same problems were faced in the pedigree line series. This series also included derivatives of B. 181, which are very promising, except that the staple is at present unsatisfactory; derivatives of S.G. 23/8, which appear still to be very unstable; and derivatives of U.4, which, however, still have a poor record in Buganda. Mass selection of Buganda Local was continued and further progress made in the improvement of lint quality, but there was a tendency to slight loss in yield. The hybrid series was continued along routine lines. The chief interest at present centres round the attempt to bring resistance to Blackarm into the B.P. 52 family using B.181 as a resistant type, at the same time maintaining the lint quality of the former.

VARIETY TESTING.

In a series of eight district variety trials B.P. 52, B.P. 104 (ex S.G. 23/8) and the mixture "X" were tested against Buganda Local. In a season when Blackarm was a good deal more prevalent than for some time past B.P. 52 fell somewhat below Local in yield. At Bukalasa the same varieties were tested, and in addition B. 181 (ex Local), U.B. 24/4 (ex Gatooma U.4/130), S.P. 84 (ex U.4/4/2) and S.P. 102 (a hybrid between S.G. 29 and an unknown cotton). B.181 was the most free from Blackarm and Wilt. S.P. 102 was also very resistant to Blackarm. B. 181 gave the highest yield, followed by S.P.84 and S.P.102. B.P.52 gave the longest lint, followed by the mixture and S.P.102.

INCREASE.

The main increase block was planted with B.P.52 which yielded at the rate of 475 lbs. per acre. The seed from this has now been put out to native cultivation in the segregated area at Kawanda.

SPINNING TESTS.

Tests were carried out by the British Cotton Industry Research Association in Manchester, and by the Indian Central Cotton Committee in Bombay. There is no doubt that B.P.52 is a big advance on Local; the Highest Standard Counts averaged 69 and 46 respectively.

CULTURAL EXPERIMENTS.

Early planting, May *versus* June and later, and close spacing, $3' \times 1'$ *versus* $4' \times 1\frac{1}{2}'$, were once more vindicated. Two plants per hole yielded better than one at both spacings. Interplanting with one row of groundnuts had a depressing effect on the yield of cotton.

INSECTS.

Lygus and *Helopeltis* were prevalent for a time on May-sown cotton, but it cannot be said that Bukalasa is faced with any major entomological problem at the present time.

DISEASES.

Wilt.—The observation of progenies grown in plots where wilt is known to be prevalent has continued. No exact conclusions can be drawn at present, but there are some indications which may prove useful in guiding our attack on the problem :

- (1) Wilt appears to be more prevalent on fertile soil; its intensity increases near the base of eroded slopes; it diminishes when cotton cultivation is sustained year after year in the same plot.

- (2) The Buganda Local strain appears to have more resistance than any Bukalasa Pedigree or introduced variety.
 - (3) The internal or chronic symptoms are likely to be found in more than half the population of all Bukalasa Pedigrees and introduced varieties alike.
 - (4) The external or acute symptoms occur more frequently in the B.P. 50 family than in the B. 181 family or Nyasaland Upland families (S.G. 23/8 and B.P. 52).
 - (5) There is no shred of evidence as yet that more resistant populations are obtained by planting seed from plants which have escaped attack in infected areas.
-

SERERE ZONE.

BY

H. R. HOSKING AND J. D. JAMESON.

SEASON.

The "dry season" of 1937 was rather wetter than usual, but this was followed immediately by a comparatively dry April. May was wet and conditions were generally ideal for early cotton planting. June was dry, and there was another lull in September, but on the whole the rainfall during the planting and growing seasons was much above the average. This resulted in large woody plants, and also caused the optimum sowing date to shift down to mid-June, because the cotton planted prior to this received too much moisture and expended its energies in developing wood rather than bolls. Despite the vagaries of the weather, and the high incidence of jassid, yields were again above average, although at one time it could not have been foreseen that the season was going to turn out so well.

The shortage of rain in September, coming in a long period of high precipitation, caused considerable variation in lint length and staple character.

DISEASE AND PESTS.

Owing to rather wet conditions during the growing months and to a few slight hail storms, Blackarm disease was rather more serious at Serere than in the previous seasons.

Jassids were found in larger numbers than have been recorded here before. The susceptible strains showed marked symptoms of jassid damage, and for the first time it was found possible to correlate low yield with high jassid population on a statistical basis.

The grade of the crop was decidedly below average as it contained a considerable amount of *Nematospora* stain.

COTTON BREEDING WORK.

The Pedigree Line Series comprised four main groups. The first group consisted of U.4/4/2 derivatives, the second re-selections from S.P.102 (S.G.29 hybrid), the third re-selections from N.17 (Nariama family) and the fourth further selections in the Bukalasa strain of B.P.50.

The U.4/4/2 lines were all derivatives of S.P.87 through S.P.92 and S.P.99.

They were not as promising as the previous season's selections, except in respect of jassid resistance and ginning percentages. They showed a tendency towards Blackarm susceptibility and yields were low.

The S.P.102 derivatives have maintained their resistance to Blackarm and jassids and showed a satisfactory improvement in ginning percentages.

The Nariama group continued to show resistance to Blackarm but in other respects proved disappointing.

In the B.P.50 group, the re-selection line B.P.50-S.6 was outstanding, especially in regard to improvement in Blackarm resistance and ginning percentages.

The hybridisation section of the breeding plot included reference rows of the parental types, F_1 , F_2 , and F_3 generations of simple crosses and F_1 and F_2 generations of back crosses. Several of these hybrids have high jassid resistance coupled with high resistance to Blackarm disease while certain individual plants have produced very nice lint. If these types can be fixed a big advance will have been made.

The New Selection Series consisted of sixty selections from Nyasaland Upland, two re-selections from a mixed Cambodia population, and thirty re-selections from U.4/4/2.

In addition six so-called commercially wilt resistant varieties from the U.S.A. were grown. These, with the exception of one plant, gave a very fine demonstration of acute jassid susceptibility owing to their glabrous leaves.

Of fifteen re-selections from Busoga N.17, three were outstanding for Blackarm resistance, while four were very hairy and resistant to jassid.

FIELD EXPERIMENTS.

1. *Miniature Variety Trial—Serere*.—The trial contained 7 varieties replicated in 6 randomised blocks. Each plot consisted of 3 rows of 50 plants each at $3' \times 1'$ spacing. Only the centre row of each plot was utilised for yield or insect population comparisons.

The trial was utilised to determine whether the various seed types of Busoga N.17 yield differently and react differently to insect pests. S.G. 29 and S.P.88 were also included, the former being fairly resistant to jassid and susceptible to Blackarm. Four seed types of Busoga N.17 were tested, *i.e.*, heavy white fuzz, normal white fuzz, very sparse white fuzz and naked seed.

(i) *Results*.—No significant differences could be demonstrated in the comparisons of yield, vegetative efficiency and ginning percentage.

There were indications that N.17 Normal White fuzz is more susceptible to Blackarm disease than the other three seed types.

Naked seed appeared to be associated with glabrous plants, since naked and sparse fuzz types were on the whole more susceptible to

jassids than heavy and normal fuzz seed types. A surprising result was the comparatively high ginning percentage of naked seed.

2. *Combined Variety, Spacing and Sowing Date Trial—Serere.*—This experiment was similar in design to that of last season.

Treatments :—

<i>Sowing Dates :</i>	mid April. mid May. mid June. mid July.
<i>Spacings :</i>	$3' \times \frac{1}{2}'$. $3' \times 1'$. $3' \times 1\frac{1}{2}'$.
<i>Varieties :</i>	S.G. 29 (Control). S.P. 20 (ex U.4/4/2). S.P. 84 ("). S.P. 90 ("). S.P. 92 ("). S.P.102 (ex S.G.29 hybrid).

(i) *Yield Results.*—The whole trial averaged 855.9 lbs. of seed cotton per acre and 191.8 lbs. of first quality lint per acre.

(a) *Varieties.*—

S.P.20 gave the highest yield.
S.P.84 and S.P.102 were equal second.
S.P.90 and S.P.92 were equal third.
S.G.29 gave the lowest yield.

In the previous season S.P.20, S.P.84 and S.G.29 were placed similarly.

(b) *Sowing Dates.*—There were no significant differences between yields for different sowing dates. Mid-July sowing gave significantly lower ginning percentages than the earlier sowing dates.

(c) *Spacings.*—The $3' \times 1\frac{1}{2}'$ spacing gave lower yields than the other two spacings between which there was no difference.

(d) *Interaction of Variety and Spacing Date.*—The yields of all varieties were of an ascending order for the first three sowing dates with reduced yields varying in amount according to variety for the last sowing date.

(e) *Blackarm disease.*—The intensity of Blackarm between varieties (irrespective of sowing dates or spacing) is shown below. "Blackarm intensity" denotes the number of lesions per pound of plant material.

<i>Varieties.</i>	<i>Mean lesions per plant.</i>	<i>Mean Blackarm intensity.</i>
S.G.29 	2.72	8.94
S.P.20 	0.86	3.04
S.P.84 	1.20	3.76
S.P.90 	1.17	4.46
S.P.92 	1.31	4.73
S.P.102 	0.59	1.87
Least significant differences ...	0.16	0.59

As in the previous season S.G.29 is the most susceptible variety in the trial.

3. *District Variety Trials*.—Fourteen 4×4 Latin Squares were laid down at fourteen centres in the area east of the Nile. The varieties S.P.20, S.P.84 and S.P.90 were included in all these trials, with N.17 as control in the Northern Province and Busoga and S.G.29 as control in Teso, Bugwere and Budama.

In addition, the Busoga trials were duplicated so that the Bukalasa strain B.P.52 and the mass-selected population from Busoga N.17 (known as N.17/M.1) could be compared with ordinary Busoga N.17 and the Serere strain S.P.102.

These trials gave an average yield of 1,087 lbs. per acre of first quality cotton which is the highest average yield yet obtained in this series, and is equivalent to over three-quarters of a bale per acre of first quality lint.

(i) *Yield Results*.—S.G.29 gave the lowest yields at all trials in the S.G.29 areas, and, even in a season of high yields, gave yield figures which were a long way behind those of the new strains. N.17 on the other hand gave a remarkably good performance. S.P.102 was conspicuously successful in the second series of Busoga trials, and gave yields of first quality cotton ranging from 927 lbs. per acre to 1,917 lbs. per acre.

S.P.84 gave unexpectedly high yields compared with S.P.20 despite being a rather more "delicate" cotton than the latter.

(ii) *Blackarm disease*.—The chief conclusions drawn from the Blackarm lesion counts on these trials are as follows:—

(a) The control varieties N.17 and S.G.29 are consistently more susceptible than any of the S.P. varieties.

(b) Mass selection in N.17 (N. 17/M.1) has not resulted in an increase of resistance.

(c) S.P.102 is the most resistant of all varieties.

(d) S.P.84 is on the whole more susceptible than S.P.20, but is still better than the control.

(e) B.P.52 is more susceptible than the control N.17.

COTTON SEED MULTIPLICATION.

S.P.102 was planted in the 2-acre increase stage at Serere and gave a yield of 1,180 lbs. of seed cotton per acre. Of an original stand of 10,090 plants, 146 plants were rogued out as they showed signs of active Blackarm disease. A further 522 plants developed slight Blackarm, but roguing was not considered necessary. This was easily the best cotton on the farm; the grade was particularly good, only 15.5% of the total crop being below first quality.

The main bulk increase (40 acres) was planted with S.P.84 and gave an average yield of 654 lbs. of seed cotton per acre.

The same strain was used for planting up 348 acres in the Mulondo segregated area (400-acre stage). Weather conditions were very unfavourable and the average yield over the whole area was only 193 lbs. of seed cotton per acre.

The 4,000-acre stage of increase was planted with S.P.20. An average yield of 319 lbs. per acre was obtained which compares very favourably with the yield of 193 lbs. per acre from S.G.29 for the previous season.

SPINNING TEST RESULTS.

Samples of the 1936-37 crop were submitted to the Shirley Institute by courtesy of the Empire Cotton Growing Corporation. The following is a general summary of the results.

"S.G.29 (Serere) and S.P.102 (Serere) are the longest samples, while S.P.20 is "the shortest.

"N.17 (Busoga Variety Trial) has the lowest hair-weight, and is the strongest "sample. S.G.29 (Serere) is nearly as strong as the N.17 sample, but is much inferior "in appearance.

"Judged by both yarn strength and yarn appearance S.P.84 (Serere) is the next "best to N.17 (Busoga)."

Making allowances for "place effect," this is a very favourable report for S.P.84 and should be read in conjunction with its satisfactory performance in the variety trials of the 1937-38 season.

COUNT $\times$ STRENGTH CONSTANTS.

Variety.	Where grown.	At 30's.	At 50's.	At 60's.	Brokers' valuation.*
S.P.84	Serere	2,417	2,199	1,909	120 on
S.G.29	Serere	2,406	2,232	2,064	110 on
N.17	Busoga	2,456	2,337	2,070	120 on
S.P.20	Busoga	2,173	1,937	—	100 on
S.P.20	Serere	2,017	1,832	1,495	100 on
S.P.102	Serere	2,264	1,996	1,730	Not valued

* Based on January, 1938, American Middling Futures at 4.75d.

It is only fair to add that the sample of S.P. 102 was grown on poor soil, and the lint sent for test matured very late in the season owing to the plot being nearly grazed to the ground by cattle.

PERMANENT MANURIAL TRIAL.

This trial was established at Serere in 1933 and some interesting results have now been obtained.

The trial consists of a 5×5 Latin Square with five manurial treatments applied during a simple four-course rotation which includes three green manure crops.

The manurial treatments, applied at three-year intervals before planting the green manure in the first course, are as follows:—

1. Control; no manure.
2. Lime 2 tons per acre.
3. 10 tons farmyard manure per acre.
4. 20 tons do.
5. 30 tons do.

The following table summarises the results to date.

YIELDS PER ACRE, LBS.							
<i>Year.</i>	1933-34.	1934.	1934-35.	1935.	1936-37.	1937.	1937-38.
<i>Crop.</i>	<i>Cotton.</i>	<i>Finger Millet.</i>	<i>Cotton.</i>	<i>Ground-nuts.</i>	<i>Cotton.</i>	<i>Finger Millet.</i>	<i>Cotton.</i>
Control ...	390	1,861	445	275	560	441	431
Lime 2 tons ...	332	2,372	410	252	574	608	537
10 tons F.Y.M....	390	2,403	579	275	755	589	859
20 tons F.Y.M....	364	2,193	567	293	746	608	884
30 tons F.Y.M....	283	2,399	577	306	798	768	1,007
Significant differences ...	None	None	130	None	150	None	179

Cotton: Yields of total seed cotton.

Millet: Yields of unthreshed heads.

Groundnuts: Yields of unshelled nuts.

It will be seen that the last cotton crop is the largest since the beginning of the experiment, and while the F.Y.M. treatments have given their highest yield, both control and lime have given lower yields than in 1936-37.

It is indicated therefore that green manure only, and lime (2 tons per acre) plus green manure, are not keeping up fertility, whereas the three farmyard manure treatments with green manure have resulted in increased fertility after seven crops.

It is worthy of note that the finger millet and groundnut crops have not as yet responded to a significant extent to the three levels of farmyard manure, and the former in fact appears to be giving reduced yields as the experiment progresses. The yields of groundnuts in 1935 were extraordinarily low. All the plots, irrespective of treatment, now have the appearance of light, compacted, run-down soil; in fact it is hard to believe that such soil could give yields of 1,000 lbs. per acre of seed cotton. One is forced to conclude therefore that the deep-rooted crop (cotton) is feeding on plant nutrients which have been leached down into the lower soil levels, while the surface feeding crops (millet and groundnuts) are being virtually starved.

SUMMARY.

For the third successive season high yields of cotton were obtained at Serere and in most districts east of the Nile.

The yields of the District Variety Trials are the highest recorded since these trials were commenced.

Once again results point to N.17 being a more successful cotton than S.G.29 when in general cultivation.

S.P.84 and S.P.102, two very promising new strains, did extremely well. The former is derived from U.4/4/2 and has come through three seasons' spinning tests with flying colours. The latter, a hybrid found in a S.G.29 re-selection, is the most resistant strain yet produced to Blackarm, jassid and lygus. It also carries lint classed by local brokers as the equal of S.G.29.

Early planting of cotton was not so successful as usual.

[Included by courtesy of the Tanganyika Government.]

TANGANYIKA TERRITORY.

UKIRIGURU EXPERIMENTAL STATION, AND NYAMAHONA EXTENSION, UZINZA, PROGRESS REPORT FOR THE SEASON 1937-38.

BY
D. THORNTON.

METEOROLOGICAL.

The total rainfall for the season was above the average, but the erratic distribution and precipitation seriously affected all late-sown crops; the "short" rains were quite good and early planted crops, especially cotton, made good growth. After December, planting conditions were bad and many cultivators were unable to plant up a normal acreage of crops.

EXPERIMENTAL WORK.

Cotton.—The clear hot weather alternating with heavy showers during the growing period proved ideal for the well-established crop, and on the station good growth and freedom from disease was reflected in the high yields obtained.

Strain Testing.—No new selections made from local cotton were outstanding in the strain trials, but a number of the earlier selections continued to show their superiority over local cotton. The following are the most promising :—

Strain Nos.										Yield of seed cotton in lb./acre.
Mz 655	...	...	...	...	...	...	...	...	...	1,021
Mz 561	...	...	...	...	...	...	...	...	...	978
Mz 570	...	...	...	...	...	...	...	...	...	951
Mz 601	...	...	...	...	...	...	...	...	...	908
Mz 613	...	...	...	...	...	...	...	...	...	891
Control, local cotton	...	...	...	...	...	...	...	...	...	806

Over a period of five years the following strains have given an average annual percentage increase over control of :—Mz 561, 32·0% ; Mz 613, 9·2% ; Mz 655, 17·2% ; Strain No. Mz 457, which has unaccountably failed this season to maintain its earlier promise, showed the highest increase of 39·7% (over a period of four years).

All these cottons are up to standard in quality and are fit to replace the local cotton ; three, Mz 561, Mz 613 and a mixture of strains were

multiplied up as a final test this season before taking one of them forward to the bulk multiplication area; a commercial spinning report is required before the final choice is made.

A large number of re-selections were made from strains 457, 561 and 613.

Variety Testing.—The variety trial contained three types of cotton (a) a mixture of three good selections from local cotton; (b) Mz 561, a selection from local; (c) 998 the highest yielding U.4 derivative from the adjacent district of Shinyanga.

Variety.										Yield of seed cotton in lb./acre.
Special mixture	...	...	...	...	...	...	...	...	...	870
Mz 561	...	...	...	...	...	...	...	...	...	792
998 (U.4 derivative)	...	...	...	...	...	...	...	...	...	740
Local cotton (Control)	...	...	...	...	...	...	...	...	...	572

The three new cottons gave significantly higher yields over the local, the difference in yield between the special mixture and 998 was also significant, but that between 561 and 998 was not.

The great value of early planting was again demonstrated. In previous seasons the yields generally have been proportional to the earliness of sowing, but this season the late plantings were a complete failure.

Planting date.										Yield of seed cotton in lb./acre.
October 31	...	...	...	...	...	...	...	...	...	824
November 15	...	...	...	...	...	...	...	...	...	838
November 30	...	...	...	...	...	...	...	...	...	755
December 15	...	...	...	...	...	...	...	...	...	510
December 30	...	...	...	...	...	...	...	...	...	34
January 14	...	...	...	...	...	...	...	...	...	19

Jan. 29, Feb. 13, Feb. 28 and March 15—Failures.

The amount of staining in cotton planted on different dates was very small and not significant.

The development of cotton in the trial of treatments on heavy soil (mbuga) was poor owing to delayed planting, but one treatment, manuring with farmyard manure at a rate of five tons to the acre, gave an increase of 61% over the untreated plots.

The residual effect of three tons per acre of farmyard manure which was applied to the previous year's bulrush millet crop gave a 9% increase of seed cotton over the untreated plots, but the difference is not significant.

At Nyamahona Extension Farm a series of observation plots of various treatments were laid down in a "miombo" soil area; these soils have proved unsuitable for cotton in some parts of the Territory.

Seven treatments were tried, half of each plot being cultivated on the flat and half on ridges; the total yield of all treatments grown on ridges showed an increase of 47% compared with those grown on the flat.

The following treatments gave marked increases in yield over the untreated plots:—

<i>Treatment.</i>	<i>Yield of seed cotton in lb./acre.</i>
Farmyard manure, 5 tons/acre	490
Sulphate of Ammonia, 200 lb./acre	450
Farmyard manure, 2 tons/acre	400
Compost, 2 tons/acre	390
Untreated plots (Average)	273

Treatments involving liming, dressing with wood ash and topping the plants were shown to have no value.

Cotton multiplication.—A preliminary multiplication of some of the better cotton selections was carried out at Nyamahona and, although yields are still low, a great improvement over previous seasons' returns was recorded; the dry season, and the fact that all cotton was cultivated on ridges contributed to this result. Mixed farming with the production of considerable quantities of farmyard manure and compost is being advanced and should result in still bigger improvements in yield from the bulk multiplication area.

<i>Cotton.</i>	<i>Yields of seed cotton in lb./acre.</i>
Strain No. Mz 561	479
" 613	642
" 457	328

The average yield of all cotton grown on the farm was 415 lb. per acre.

ROTATION CROPS.

In the sorghum variety trial Bukara Masara and Bukara Mahemba again gave the highest yields despite serious damage by aphid; of the quick maturing varieties Kabunde was the best, displacing Nzanza which showed great promise in previous seasons, but this latter variety, a three months' sorghum, gave an average of 1,100 lbs. to the acre in a bulk multiplication at Nyamahona.

Previous seasons have shown that a moderate wide spacing of sorghum, 3ft. between lines, gave the highest yields, but this season the poor development of the plants favoured the closer spacing and 1ft. between lines and broadcast gave the highest yields.

Maize again proved the heavier cropper compared with a number of varieties of sorghums and bulrush millet when grown on striga-infested land.

The value, in a dry year, of Katumbili maize, a quick maturing local selection was demonstrated; this season it gave a yield equal to that of Kenya Hybrid, which is normally a much heavier cropper.

In a variety trial of groundnuts two quick maturing varieties, Virginia Bunch and Barberton, both gave yields equal to the slower maturing selections from local groundnuts, but all proved superior to the unimproved local mixture.

Only a few of a number of introductions or selections were of much value, but one sorghum, Kobero from Morogoro District, was promising and a new long-headed quick-maturing bulrush millet found in a neighbouring district is providing good material for further selection work.

MANURIAL TRIALS.

In the trial to test different rates of application of farmyard manure, 3 tons of farmyard manure gave a 36% increase in yield of grain over the control; and 5 tons gave lower increases. All differences were significant.

A further application of 8 tons to the acre of farmyard manure was made to the plots of the first manurial experiment laid down at Ukiriguru in 1932 because there was some doubt as to whether a similar response to manuring would be obtained after repeated dressings; cropped with bulrush millet an increase in yield of grain of 40% was obtained from the treated compared with untreated plots.

The residual effect of green manure crops applied in 1935 and tested with groundnuts this season was negligible although all previous seasons have shown considerable residual manurial values from the use of sunnhemp.

A series of manurial observation plots of cassava gave marked increases in yields from the use of heavy dressing of farmyard manure.

<i>Rate of application of Farmyard Manure.</i>										<i>Increase in yields of fresh roots over untreated plots.</i>
5 tons per acre	...	...	...	...	...	...	...	...	...	13%
10 "	"	"	"	...	...	...	...	...	...	69%
20 "	"	"	"	...	...	...	...	...	...	103%

Natives stated that the roots from the manured plots were not as palatable as those from the untreated plots; the dried root has yet to be tested.

Seed Farm.—Very fair yields of all crops were obtained despite the fact that the season was an unfavourable one for grains. The seed multiplication area gave a good demonstration to local natives of the value of early planting, manuring, etc., as most of the crops in the farm were superior to the local cultivators' crops.

Natives were issued with forty-five tons of seed from selected varieties of rice, maize, sorghum, groundnuts, eleusine and sunnhemp.

There was a demand for small quantities of a wide range of varieties of crops from other parts of the Territory and from abroad ; over three hundred parcels were despatched.

Peasant Holdings and Settlement.—No increase in the number of settlers at Nyamahona or Ukiriguru took place as the aim is fully to develop the existing holdings before encouraging any extension.

At Nyamahona Settlement there are 186 settlers and with a few exceptions they have done well ; all obtained ample food and the average cash received from the sale of the crops of seven holdings taken at random was 95 shillings, the highest being 150 shillings, the lowest 35, the main cash crops produced were cotton and cassava.

Settlers are now bringing cattle into the area and the development of mixed farming will enable them to maintain a higher production than at present.

Building better houses and growing a wider range of food crops are being encouraged and are taking place, and it is hoped this will lead to a healthier and more contented people, which will be a demonstration for the whole of Uzinza.

In the densely settled area of Nyanza Federation it is difficult to mark out holdings, but in the Gunguli of Bugalula an energetic headman and his people are anxious to develop mixed farming, and slow but steady progress is being made.

In the District, and especially in the Nyanza Federation, the first step in mixed farming has taken place and for the first time a large number of cultivators have applied cattle manure to their land ; this, and the fact that a small number of cultivators have agreed to use sunnhemp as a green manure shows that at last some interest in maintaining the fertility of the soil has been aroused.

Education.—A new training holding was started at Ukiriguru, and four youths spent the full cropping season working it. They learnt to train and work oxen, take care of dairy animals, feed and bed their stock, use manure on their land, and a number of improved cultivation practices. One of the men was a failure, one has started farming on his own and two have asked to remain for another year.

As in previous years, short refresher courses were held for the Agricultural Instructor staff and a course was held for Native Administration Market staff in produce inspection, weighing, etc.

Local Chiefs, Headmen and their people visited the farm during the cropping season ; one Chief was resident on the farm for a period of two months to learn agricultural work.

The buildings for the new training centre for field staff were constructed at Ukiriguru. At present this centre serves for training the Native Administration staff of the three contributing districts and our Departmental staff. Four sets of dormitories, two large class rooms, teachers' house, etc., were erected and the layout allows for additional buildings when other districts join the scheme.

At present short courses are being held at the School; the main course of eighteen months' training is to start at the beginning of next year.

LUBAGA EXPERIMENTAL STATION, SHINYANGA, PROGRESS REPORT, 1937-38

BY

J. G. M. KING.

INTRODUCTION.

Lubaga serves the hinterland area of Sukuma as an Experiment Station, Native Administration Seed Farm, and as an Education Centre. The maintenance of soil fertility by the adoption of anti-soil erosion works, the conservation of water supplies in open surface catchment tanks, and the application of the principles of mixed farming all form part of this endeavour; while, in addition, facilities are available for training cattle belonging to natives for pack work and cultivation with a view to the ultimate adoption of mixed farming methods.

METEOROLOGY.

An abnormal season was experienced. The total precipitation was 28.3" as compared with the average of 32.3", but the distribution was most irregular. Unusually heavy early rains were experienced in November, while in December the normal planting rains were exceptionally poor, resulting in the disorganisation of native planting. Throughout the whole rainy season long dry spells were experienced so that poor plant stands were obtained.

COTTON EXPERIMENTS.

Variety Trials.—The uneven plant stand caused by the uneven distribution of the rainfall made it necessary to calculate results on the yields per plant in order to obtain significant results. The varieties 998, 9264 R and 921 gave significantly higher yields than the control U.4/4/2. This is the fourth year in succession in which the variety 998 has given significantly greater yields than the local cotton.

Another trial was planted at Ibadakuli this year, but was a complete failure.

Selections.—Ninety-eight selections from the more promising strains were planted; these included selections made from 998 and U.4/4/2.

Further single-plant and mass selections were made in the district and on the farm from 998, U.4/4/2 and U.4 bulk in the latter part of the season.

Time of Planting Experiment.—This valuable experiment was again planted and results obtained in previous years were confirmed. It

was again conclusively proved that the optimum time-of-planting is from mid-December to mid-January.

Residual Value of Manure Trial.—The plot yields in this experiment were very disproportionate and variable and significant results were not obtained.

Demonstrations.—Small plots were planted to demonstrate the value of different types of cultivation. Cotton was planted on the flat, on ridges and on tie ridges; there was little difference in yield. The ridges are of value as an anti-soil erosion measure.

Seed Multiplication.—Nineteen acres of 998 were planted as a field-scale trial and for seed multiplication. The average yield was 814 lb. seed cotton per acre, which is very satisfactory for this district. In addition to 998, one acre of U.4 bulk was planted and yielded 602 lb.

A very high percentage of the 998 was stained; this was partly attributed to the fact that with the uneven rainfall the cotton began bolling during the end of the rains.

PESTS AND DISEASES.

During early May some damage was done to cotton by white ants and in the latter part of that month a severe infestation of jassid did considerable damage. In June and July stainers (*Dysdercus fasciatus*) were very prevalent and were largely responsible for the high percentage of stained cotton in the multiplication fields of 998 and U.4 bulk. The percentage of clean cotton was only 18.5 per cent. Small numbers of *Callidea dregei* were also seen.

GROUNDNUT EXPERIMENTS.

Some selections from various local and imported varieties were made; these are to be multiplied and tested in the main groundnut variety trial.

The plot yields in the main variety trial were very variable and disproportionate; significant results were not obtained.

MAIZE.

Variety Trial.—The trial of maize varieties was continued, but the yields were seriously affected. The quick maturing native varieties withstood the adverse conditions and gave better yields than the imported varieties.

MANURIAL TRIALS.

Two experiments using bulrush millet were started to determine the optimum application of farmyard manure to different soil types, one at Lubaga on a black soil and the other at Ibadakuli on a red granite

soil. At Lubaga the application of 2, 4 and 6 tons of farmyard manure gave no significant results, but an increase in yield was obtained. At Ibadakuli a dressing of nine tons per acre gave an increase in yield of thirty-two per cent.

DEMONSTRATIONS.

The three exhaustion and timing plots laid down in 1935-36 were planted again with cotton, Virginia Bunch groundnuts and sorghum. Witchweed (*Striga sp.*) was very bad and considerably depressed the yield of sorghum. No general trend is as yet evident. The number of man-hours required to plant and cultivate the different crops were as follows:—54½ man-hours for one acre of cotton, 51½ man-hours for groundnuts and 182½ man-hours for sorghum.

OTHER CROPS.

Various crops were grown on the farm either for seed distribution, for feeding stock, or for supplementing the labour rations. These crops chiefly consisted of the quick maturing varieties of maize, groundnuts and sorghums. Good yields were harvested from all the main crops of the farm in spite of the adverse conditions, while in the neighbourhood of Lubaga the native crops were very poor. This has had a profound effect on the natives of the district. The comparatively good yields obtained on the farm can be attributed to the fact that the land is in good heart, and in particular to the beneficial effects of (a) the anti-soil erosion methods; (b) the maintenance of soil fertility by the use of farmyard manure; and (c) early planting. These satisfactory results will, undoubtedly, go a long way towards assisting the introduction of mixed farming to native agriculture.

EDUCATION.

There were only four men in residence at the adult school throughout the year, which was disappointing. After very careful investigation, with the assistance of Chiefs Wamba and Makwaia, into the causes of the failure of this project, it was found that, while the desirability of the scheme was admitted, practical difficulties would preclude any possibility of success for the time being unless radical changes were made. The Chiefs considered that a one-year course on training holdings would be preferable, and that these should be commenced at a later stage when the effects of the district manurial campaign are beginning to be felt. At their request a start has been made with a small school for children of both sexes, to be run entirely on indigenous lines. The children will be housed and looked after as they would be in their own homes, and will receive simple instruction in agriculture

and animal husbandry, while, in addition, they will be given simple schooling in the evenings.

Special short courses on general native agriculture were held for the Instructor staff, and on marketing supervision for the market clerks. The evening classes in Reading, Writing, and Arithmetic for the labour continue to be very popular.

As in previous years, the ploughing school was available for training oxen. Indiscriminate ploughing in many parts of Sukumaland is highly dangerous and oxen are now first trained for pack work. When pack work has been mastered the oxen are returned to their owners to enable them to cart out manure from their kraals. Later, a final period of training in plough work is given.

As a result of the preliminary manuring propaganda, the response to the offer to train cattle for pack work has been remarkable. In two months over one hundred and fifty head of cattle belonging to the natives were sent in for training.

Arrangements were made with various firms to have a number of the more useful agricultural implements on permanent display. The prices are clearly marked and the native can now inspect the implements before placing an order for those he wishes to purchase.

PEASANT HOLDINGS.

In spite of adverse conditions this season, the peasant holders obtained fair returns from their farms. The receipts from cash crops were low, but the food crops were satisfactory. The peasant holders at Ibadakuli suffered more severely from the effects of the uneven rainfall.

DEVELOPMENT OF STATION.

Water.—In view of the increased demands on the water supplies of the farm, an additional tank dam (size 140'×36'×16' deep) was constructed, by means of dam scoops and oxen, in the main catchment at the bottom of the farm. The main overflow was stoned and cemented to prevent scouring.

Building Work.—A permanent building was erected to house the stocks of tools and implements for exhibition and sale to the natives.

Cattle Byre.—The interior of the cow byre was entirely reconstructed and stalls for the milking cows and calf pens were erected. Each milking cow has its own stall and its respective calf pen in front of it.

School Buildings.—Two native huts are in the course of construction for the agricultural school.

MOROGORO EXPERIMENTAL STATION AND KINGOLWIRA EXTENSION FARM:

PROGRESS REPORT FOR THE SEASON 1937-38

BY

N. R. FUGGLES-COUCHMAN.

SEASON.

Rainfall.—This season has again been one of low rainfall. During the period October–July, 1937–38, the rainfall registered at Kingolwira was $8\frac{1}{2}$ inches less than in the corresponding period of 1936–37. The short rains (November–December) were rather early and below average near the mountains, and they were a partial failure at Kingolwira. They were followed by long dry spells with intermittent rainfall; the long rains (March–May) were late in commencing, and of below average intensity. Early sown crops were difficult to establish or failed, and grain crops generally were light, but cotton has again been well suited by the climatic conditions and yielded heavy, clean crops.

MOROGORO EXPERIMENTAL STATION.

Cultural Experiments.—The ridging of the land for maize has shown, for the third year, a large increase in the crop over the normal native practice of planting in undug land. Digging (*i.e.*, ploughing) gave results comparable with ridging, but over the three-year period of the experiment ridging is shown to be superior to digging, which in its turn is superior to the native practice. Ridging appears to be of most value in a dry season. The spacing of maize at $4' \times 1'$ with a single plant stand has given a significant increase over the native practice of wide spacing leaving four plants per hole. This corresponds with the serial results over three years.

Variety Trials.—The sorghum varieties Kobero and Jebere, which have done so well in the past, gave yields significantly greater than the other varieties this year. Over the three-year period they are shown to be better than all other varieties.

Results in the sweet potato variety trials follow closely those of previous years. The imported variety, Calabash Leaf, again gave higher yields of roots and, with the exception of one variety, of vines.

In a second trial of some varieties collected from other districts, Vidwidwi was the most promising and should prove to be superior to Calabash Leaf.

High yields appear to be correlated with low carotin content ; amongst varieties giving lower yields are some good yellow fleshed types.

Barberton groundnuts and the local native creeping variety gave considerably higher yields than Virginia Bunch. While the Barberton variety does not appear to yield better than the native type under Morogoro conditions, its " bunch " habit recommends it both for native and plantation use, as the costs of harvesting and losses of nuts are much reduced.

Green Manuring.—The practice of green manuring with sunnhemp has been proved of more certain value than manuring with kraal manure or composts under conditions on the Morogoro station, but it appears to have no residual value. This year the increase in crop from green manured plots was equivalent to $3\frac{1}{4}$ bags of maize per acre over plots in which weeds were turned under, and to 4 bags over untreated plots. The practice of green manuring was costed on a field scale and gave a figure of Shs. 2/07 per acre covering the costs of broadcasting the seed, cutting and ridging over with ploughs.

Manurial Trials.—Responses to dressings of kraal manure and composts alone still remain insignificant both in the first year of application and in subsequent years. A new experiment, using maize, was laid down this year in which a dressing of 4 tons of kraal manure per acre was supplemented with dressings of 1 ton of lime and 1 and 2 cwts. of superphosphate per acre.

The application of kraal manure plus lime gave a significant increase of $2\frac{1}{4}$ bags per acre over plots unmanured. The dressings of superphosphate depressed the yields and the inference is that the lack of response to kraal manure on the station is due to the acidity of the soil. The increase in yield in this first year alone, from the dressing of kraal manure and lime, would not be economic and the residual effects of the liming are awaited with interest.

CASSAVA INVESTIGATION.

Two variety trials, one planted with setts diseased with mosaic, the other with apparently disease-free material, were harvested this year. One variety, Mpera, gave the best yield from both trials, and it appears that there are two or three varieties which are tolerant of mosaic and yield well under most conditions. A trial planted with setts,

seedlings transplanted and seed sown *in situ*, showed that the usual method of planting by setts is definitely superior.

Seed taken from clonal material of varieties in the collection has been sown in between lines of diseased cassava in the first stage of the trials to obtain strains resistant to mosaic disease. Counts have been made of infection with a view to finding clones which may be good parent plants for seedling material of high resistance. Over a thousand single plant progeny of seedlings which had failed to become infected in 1937 in the first stage of the trial entered the second stage and were planted in progeny plots between other diseased rows of cassava this season. After three months only 5.8 per cent. of the plots remained free from both Mosaic and Brown Streak disease.

Seven single plant progenies which had remained free from mosaic in the second stage in 1937 were planted under isolation, but all show symptoms of Brown Streak, although Mosaic is absent from six of them. Observations on their growth are being made, but they will most probably have to be discarded.

A number of varieties reported to be resistant to Mosaic in other countries have succumbed in the nursery at Morogoro.

THE DAIRY HERD.

The maintenance of the dairy herd has been continued satisfactorily. Milk yields have been good and there has been a large decrease in the number of abortions and deaths. As more fully reported previously, the herd is almost wholly stall fed, and the improvement in the milk yields of native cattle continues to be maintained. Two young bulls, selected from native cows of good milk yield and constitution, were purchased during the year with a view to breeding up the native herd to produce heifers of good quality for the Kingolwira Settlement Centre.

There has been a reduction in the number of animals infected with trypanosomiasis, in spite of the fact that the herd is larger. Several of the cases have been relapses, as is shown by the increase in the number of courses of treatment. No further light has been thrown on the tsetse position in Morogoro during the year and it is still very obscure.

A new dairy has been built and a small steam sterilising cabinet installed.

KINGOLWIRA EXTENSION FARM AND PEASANT SETTLEMENT CENTRE.

Satisfactory development, except in regard to the tsetse fly position, can be recorded. While it has been a difficult season agriculturally, crops have generally been up to average, and the maize crops on the

extension farm have been a good demonstration of the value of ploughing in a dry season. Cotton has been excellently suited by the climatic conditions, but groundnuts cropped indifferently.

Cotton Selection and Experiments.—Progeny plots of 272 plant selections made in 1937 were planted for observation; the selections were from local cotton, 998, other U.4 derivatives, introductions from Uganda, and the complex hybrids from Trinidad. A small number of selections from local cotton show promise, and vigorous discarding has been done this year, as much is expected from one or two strains selected in 1935. Of imported strains one or two promising selections from 998, with slightly improved staple, have been carried forward, together with a very small number from the Trinidad hybrids, chiefly those having the variety “Over the Top” as an ancestor. Over 300 single-plant selections were made from local introduced strains this year.

The 61 best selections from the 1937 progeny plots were tried out in a large scale strain trial. Only a limited number showed any superiority in yield over the 998 and local controls. These included two selections from A.F.C. (U.4×Cambodia×U.4) strains received from Barberton, but as with most U.4 derivatives, the staple is not as good as the best local staple. In 1937 the A.F.C. strains showed some promise in the field, but they have been disappointing this year.

Two other strain trials were planted. The first included U.4 derivatives, bulk selections from local cotton and seed from Mwanza. For the second year no significant differences in yields were obtained, but local bulk and 998 were again at the head of the list. In ginning out-turn 998 was superior to all other varieties; local bulk, the Mwanza strain and unselected local seed were poorer than all U.4 derivatives. In the other trial ten selections from local cotton made in 1935 were compared with four Mwanza strains, 998 and unselected local seed. Two Mwanza strains and one local strain showed up particularly well. The success of the local strain is most satisfactory as reports on its lint have been very favourable. It has the drawback of not being jassid resistant, but that weakness should not be a great disadvantage in this Province. As an instance, fifteen acres of a bulk selection of local seed were planted on the farm this year, and though heavily attacked by jassid, gave the very fine yield of 920 lbs. of seed cotton per acre. The strain also gave the good ginning out-turn of 32½ per cent., which is comparatively high for local cotton. It is of interest to note here that, given a local strain of yielding power equal to that of 998, the lower ginning out-turn of the local strain is completely

offset by the lower premium for 998, and thus the local strain would be of equal intrinsic value to the country ; it might even be more valuable as the market for the longer staple would appear more certain.

All experiments and observation plots indicate that, of all the imported strains, 998 is the best all-round cotton.

Five experiments with cotton were planted relating to the following problems :—

(1) Interplanting and spacing. (2) Viability and vigour of seed from Nos. 1, 2 and 3 grade seed cotton. (3) Cultivation trial. (4) Plant stand trial. (5) Cultivation trial: the period taken from the first clearing of bush to give average crops.

Both groundnuts and cowpeas interplanted in cotton planted 3'×3' depressed the yield of cotton, this being particularly marked with cowpeas: the total cash return from the interplanted crops, however, was double that from cotton alone. A spacing 3'×1'6" gave an increase in yield over the more widely spaced cotton, but this was not significant.

There were no significant differences in yield of seed cotton from seed of the three grades, but the plant stand obtained with No. 1 seed was superior.

No significant differences in yield were obtained from cotton which had been sown in dug, ridged or undug plots, a result which is at variance with previous results and is suspected of being due to certain inherent deficiencies in the soil. In the plant stand trial, plots with 4 plants per hole gave significantly higher yields over those with 1, 2 and 3 plants per hole, between which there were no significant differences. This unexpected result is also suspected of being due to the abnormality of the soil in the experimental area ; this area will be discarded in 1939.

The experiment referred to in last year's report on the problem of lack of fertility in the deep red soils on the ridges when freshly cleared from bush, has yielded most interesting results. Maize, Bulrush millet, groundnuts and cotton were sown in plots which were in their first, second and third year of cultivation. Half the plots were dug to simulate ploughing, the other half being planted in undug soil following native custom. Maize and Bulrush millet on land freshly opened gave significantly lower yields than on land in its second and third year of cultivation. There were no differences between the second and third year: in 1937 the land now in its third year gave yields 150–200 per cent. higher than that now in its second year. Digging did not give any increase in yield in any of the three stages of cultivation. Groundnuts gave similar results, but digging proved

of significant benefit, this being particularly marked in the second year. Cotton gave very different results. The crop from plots in their third year was significantly poorer than that in the second and first year. Digging increased the crop in the first and second year, but failed to do so in the third year. The soil in the plots has been sampled and analysed by the Soil Chemist, Amani, and preliminary results show that the quantity of available phosphorus is very low. The experiment as a whole, together with this analytical result, gives some explanation of the poor results with cotton in the experimental block and the anomalous results obtained.

Cotton Multiplication.—Acre plots of the best local strains were planted for observation and multiplication. Fifteen acres of local bulk selections were planted on the farm with excellent results. The peasant holders were again issued with seed of strain 998, which yielded 550 lbs. of seed cotton per acre over 162 acres, with individual yields of over 880 lbs. per acre.

The Tsetse Position.—No improvement can be recorded in the tsetse problem in and around the farm. A visit was made to the farm by an entomologist of the Tsetse Research Department, and while his report is not yet to hand, from conversation with him the position appears to be more difficult than was believed. The migration and status of *G. pallidipes* with reference to the many thickets on the settlement centre coupled with the status of *G. austini* would seem to be more complex than was first realised. There has been no reduction in the number of *G. morsitans* caught on fly rounds. It, therefore, seems highly probable that only the very extensive and complete felling of bush and thicket will make it practical for the peasants to introduce and work cattle on their holdings. Felling a considerable number of trees remaining in the main area of development has been undertaken to reduce the attraction to flies.

A herd of fifty-five oxen and heifers has been maintained at Kingolwira. The percentage of cases of trypanosomiasis has fallen, but is still much too high for practical purposes. In a dry year the grazing on the farm has been shown to be extremely poor and cannot carry a beast to two acres; a commencement has been made on pasture improvement by planting up *Cynodon plechtostachyum*.

The Peasant Settlement.—The number of natives occupying holdings this season has risen from thirty-five to forty-six. Owing to the comparative failure of the short rains there was only a very small early maize crop, an important factor in native economy, as it tides over the frequent shortage of food in the first half of the year. This is the second year that such a failure has occurred. The only reasonable

early maize crop grown by a settler was produced by the best of the demonstration peasant holders who had ploughed his land, and provided a valuable demonstration of, and some good propaganda for, the value of working with oxen.

The late advent of the long rains enabled natives to open up more land than they could have managed had the rains been heavy and weed growth excessive. As a result, in spite of rather lower yields, the gross returns should be satisfactory, but food crops are short. Groundnuts did not do well this season, except in a few cases and owing to low prices a satisfactory proportion of this valuable food crop will be eaten. Large cash returns were again obtained by individuals from their cotton crop, in spite of the low prices. While there was some complaint at the poor price, the settlers do seem to realise that there is a profit in the crop even at such prices.

It is still impossible for any of the main body of settlers to have cattle. Better types of hand implements have been obtained for the local shop to encourage the use of at least a part of the surplus money in buying better articles. Two sun-dried brick houses have been built by settlers and others are being encouraged to spend their money in improved housing.

The Demonstration Holders.—A second demonstrator is obtaining cattle this year. The first, who has now been elected headman of the settlement, has worked most satisfactorily and the value of his ploughing has been referred to above. He has built a burnt-brick house, roofed with corrugated iron. His cattle have not been free from trypanosomiasis and one ox died from tartar emetic poisoning. As his holding is in as fly-free an area as possible, it will be realised how impossible is the general introduction of cattle to the settlers at present. A third demonstrator is very much more backward and is an interesting example for comparison with the two more energetic men.

The Prison Farm.—Progress of the Prison Camp and Settlement scheme is satisfactory. Seventy to eighty short- and long-term prisoners have been in residence during the year and have been employed on brick burning, building, farm work and bush clearing. New warders' quarters of burnt brick are being built. The short-term men have worked the prison farm of some eighty acres of foodstuffs and cotton, but it has not yet been possible to introduce cattle to the farm owing to tsetse fly. A few picked long-term prisoners have been working on a demonstration small holding and two of their number have been allowed to work on daily parole on holdings which they will take up when they are released on special licence. They have shown their

appreciation of their comparative freedom by working well. Two other men already released on special licence have settled on their own holdings with their wives and one of them has done very well. Burnt brick houses built and thatched by prison labour have been constructed for them, and the cost of cement and iron work used is being recovered from their crops. The prison is to be enlarged to a capacity of 300 ; the building and development work is carried out under the supervision of the Agricultural Assistant.

**ZOMBE FLOOD LANDS COTTON TRIALS FARM,
RUFJI,
PROGRESS REPORT FOR 1938**

BY

A. S. STENHOUSE.

General.—An area of land suited to cotton trials under flood lands conditions was found at Zombe, near Utete, and clearing work was started in March, 1938. The object of starting the new farm was to continue the trials with Tokar cotton begun at Mpanganya in 1937, and to investigate problems of the Rufji flood lands with particular reference to cotton and rice production.

Full data from the Zombe flood lands plantings will not be available until the end of the year, owing to the fact that the planting season is from June onwards and harvesting does not begin until October. Only the general trend of the trials can therefore be given in this report.

Work having started late in the season, only simple cotton trials with Egyptian Tokar cotton, and American Upland from local seed supplies, were attempted, in order to investigate time of planting and spacing problems.

Soils.—Trials were planted this year on two of the range of soil types available for investigation at Zombe. The soils planted were :—

(a) A well-drained sandy loam on the ridge above the flood levels on which a trial of Tokar and American cotton was planted under rainfall conditions.

(b) A tenacious grey to black clay loam on the flood lands. It appears to have a high humus content, great depth, and good water-retaining properties. On drying out it becomes brown, crumbly, and fragmented. It does not crack seriously, except where it has been ‘puddled,’ as along old hippopotamus paths.

Meteorological.—Rainfall at Zombe was very badly distributed, with the result that the plantings under rainfall conditions were late, gave a poor stand, and poor subsequent growth.

The River.—The Rufji River floods reached their highest point on April 23rd, when 9ft. 5in. above zero (the normal dry season level) was measured at Mpanganya. This level was maintained for a very short time and the flood did not have time to spread. At the time of the first plantings the flood level had receded to about three feet below the land surface which was planted. It has now (October) fallen

to about eleven feet below the soil level of the Zombe plantings. At the time of high flood, most of the Zombe low lands were flooded and clearing work had to be suspended.

Cotton Trials.—The trial of Tokar and American cotton under rainfall conditions has given no result owing to poor distribution of the rainfall, poor germination of the seed, poor stands, and subsequent destruction of the surviving plants by monkeys and rats. In addition, there are indications that this soil shows at least initial infertility to cotton. Growth was very poor except on ant-heaps and where deep digging for the removal of stumps had been made. On such places growth and development were much better. This trial will be continued and extended next season.

On the flood lands cotton had not been harvested when this report was written. It is possible, however, to give the following general indications from the appearance of the different plantings. It would appear :—

(a) That early clearing of the grass from the flood lands to be planted is essential to secure a good crop. The line at which clearing was suspended when the floods came is clearly marked in the plantings. The cotton in the area cleared before the floods is better than that on the area subsequently cleared.

(b) That the earliest plantings after the floods recede give the best germination, the best stands, and the most vigorous and early development of the plants.

(c) That the alluvial clay loams (typical of the most extensive areas of the Rufiji flood lands) are suited to cotton production, and the development of the plants on such soils does not give the tremendous vegetative development of the plants which is such a marked feature of cotton grown on the sandier loams of the flood lands nearer to the river bank.

(d) That the moisture-retaining properties of these clay loams is such as to ensure full development of the cotton plants independent of rainfall.

(e) That the incidence of pests and diseases on cotton grown on the flood lands is not serious.

(f) That Tokar cotton would appear to be well suited to the conditions of the Rufiji flood lands. In the later plantings, when the surface has dried out somewhat, it gives a better germination and better stands than American cotton.

(g) That although the bolls of the Tokar cotton are small, the number reaching maturity under flood land conditions is more than double that on the American cotton.

Buildings.—Building materials for the Zombe Farm buildings were obtained by demolishing one of the corrugated iron and angle iron stores at Mpanganya, as well as the smaller of the two houses there, which was in danger of being undermined by the river. These materials were transported to Zombe by canoe. A combined cotton and tool store is nearly completed, and the overseer's house is in the course of construction, both are on the ridge well above the flood level.

Game and Vermin.—The Zombe area had to be abandoned by natives about twenty years ago because of the depredations of game and vermin. It is not surprising therefore that some destruction has taken place in the trial plantings despite the constant employment of night guards. Hippopotamus, elephant, monkeys and rats (in the order of their destructiveness) have all taken their toll. Control measures have been taken with the co-operation of the Game Ranger.

Pests and Diseases.—So far the incidence of pests and diseases is insignificant.

COTTON DISEASES AND PESTS IN TANGANYIKA, 1938.

BY

G. B. WALLACE (*Pathologist*) AND W. V. HARRIS (*Entomologist*).

Diseases.—There have been very few diseases of cotton reported during the year. The only important outbreak was of Internal Boll Disease (*Nematospora spp.*) in the Moshi district: one area of forty acres was very badly infected and produced only a negligible quantity of lint. In a search for indigenous hosts of *Nematospora* around that infected area, numerous possible hosts were seen, but the only one actually found infected was a tree *Acacia*, a genus apparently not previously recorded as a host of this fungus.

Insect Pests.—The discovery of pink bollworm on the Lake Victoria shore was the most outstanding event during the year, so far as cotton pests were concerned. A survey of the Lake Province cotton was carried out and it was found that the pest had already reached Ukiriguru and Nyamahona, although the degree of infestation was extremely slight, and obviously just beginning. Infestation on Ukerewe Island and in the Musoma district was greater.

At Lubaga no pink bollworm has been found. Jassid attack was severe early in the season, and was followed by *Dysdercus fasciatus*, which caused much staining in the multiplication fields of 998 and U.4 bulk. *Dysdercus fasciatus* was also the cause of failure of the crop at the Kahe (Moshi) observation plot. Continuous records of stainer incidence and boll counts throughout the season showed that this insect had appeared abnormally early.

Kingolwira shared in the comparative freedom from pests general throughout Morogoro district and the coastal belt. Both bollworm and stainer incidence was low until late in the season with conspicuous effect on the early and main pickings. Note was taken by the Agricultural Officer of jassid attack on the cotton selections at Kingolwira early in the season. Considerable variation was found, but in all cases the plants recovered and the crop did not appear to be adversely influenced. It is, however, proposed to continue these observations in detail, with a view to keeping a high jassid resistance in the selections.

The pest situation has been favourable on the Rufiji observation plots.

The Entomologist has been chiefly occupied in survey work on cotton pests in the Lake and Southern Provinces. Red bollworm, *Diparopsis castanea*, exists in the Songea highlands and a preliminary survey was made of the locality for host plants, etc., and to define the distribution of this pest. No red bollworm was found in the Lindi, Masasi or Tunduru districts. A visit was also paid to Moshi where one of the African staff had been stationed during the season for work already referred to.

NYASALAND

COTTON EXPERIMENT STATION, DOMIRA BAY, PROGRESS REPORT FOR THE SEASON 1937-38.

COTTON-BREEDING AND FIELD EXPERIMENTS.

BY

S. T. HOYLE.

SEASON.

The total rainfall for the season was 30.40 inches, which is very little below the average and the distribution was good. The rains came late at the end of December and, with the exception of a short break in February, continued fairly evenly until the middle of April, which is rather later than usual. The bollworm attack was much less severe than last year and the stainers were less numerous. The combined effect of all these factors was that the effective growing and ripening period was lengthened. The average yield for the Station, on which no manure of any kind is used, was 270 lbs. lint per acre, the highest average which has yet been recorded.

VARIETY TRIALS.

Four variety trials were planted and with the good season which was experienced it was possible to make effective comparisons between the strains. Actually there is little change in the order of yield of the leading strains as compared with the results of the last two poor years ; there are a few newcomers at the top of the list but the most useful result is that it is now possible to discard some of the lower yielding strains with some confidence.

The highest yield was given by H.K., a cross between U.4 and Cambodia backcrossed to U.4, which was made by Harland and received here in 1933. This gave 470 lbs. lint per acre in a trial in which C-28, a standard U.4, was yielding 360 lbs. H.K. makes a very nice, compact, but not close, plant and has a very high ginning percentage. The lint feels rather coarse, but the hair weight is about the normal for U.4 cottons. The next group, yielding about 400 lbs. lint, included N-10, G-4-2 and G-4-5. These two G strains from Gatooma, which have not been in the first flight before, are tall, rather coarse types and later than most strains. The past season

has favoured them more than recent years have done. Next came a number of strains all yielding about 360 lbs. lint which included C-28, Z-14, 0101, G-4-14, G-5-79 and G-5-123. The ginning percentage of the last named is normal, but that of the others from Gatooma is low and they owe their position to their prolific cropping.

H.L. (U.4×Gambia×U.4) and N.C. (the same cross as H.K. but made locally) yielded about 380 lbs. lint. The former has very mixed lint, much of it being shorter than U.4 and the ginning percentage is low. The hairweight is low and the maturity is high and if some of the selected plants with longer lint breed true to type this may be a valuable addition to the range of cottons on the station. Other crosses which have done well are U.4×Meade×U.4 and U.4×B-30-1×U.4. H.K. is the only one of the crosses which has definitely yielded more than the best of the U.4's; the others are still mixed in habit and lint characters, but those mentioned above show promise of producing some very high cropping strains.

Seed was taken from various Native Trust Land markets and grown on the station in a strain trial with two selected strains as a control. At the first picking, when rather more than half the crop was harvested, the two Station strains were significantly better than the others; there were no differences, however, in the total yields at the end of the experiment. As has been mentioned above, the season favoured late maturing strains more than usual and, had the season closed down earlier, it is possible that the significant differences at the first picking might have been maintained. The selected strains were noticeably smaller, more compact and much more even in habit than the seed from Native Trust Land; also the ginning percentage was higher by 1-2 per cent. The same experiment repeated on a private estate gave a similar result. All the surplus seed from the station is being bulked on a private estate next season, and will later be issued to an isolated area of Native Trust Land for further multiplication.

A cultivation trial, in which no precultivation and ordinary digging were combined with ridge and flat cultivation, gave no significant result. It is possible that there may be a cumulative effect after this experiment has been running for a few years.

LILONGWE SUB-STATION.

The season started off well and at one time it looked as if there would be a really good crop. Towards the end of April, however, the plants began to go off and the finish was not as good as had been expected, although there were no frosts in June as is usually the case. This falling off was probably caused by a combination of bacterial

disease and staining. Of the strains grown L-1 and L-33 were again the highest yielders, giving over 200 lbs. of lint per acre, though a large proportion was badly stained. L-1 is a very good opener and looks much more attractive than L-33, which never really looked healthy, though there was no difference in the final yields. L-11 is another good local selection, which has a very high flowering rate, but rather small bolls and a lower ginning percentage than either L-1 or L-33. The best of the Gatooma selections were G-5-21, G-2-26, and G-4-2, which all yielded about 150 lbs. of lint. A number of new selections were made, and among these L-14 showed up well, and some plants taken from G-5-79 are promising.

INVESTIGATIONS ON RED BOLLWORM.

BY

B. L. MITCHELL.

The pupal cages laid down by Parsons are running smoothly in all districts. It is too early yet to state whether the non-emerged pupæ are in a diapause stage or dead; there appears to be little or no diapause stage at Port Herald, a certain amount at Chiromo, and a considerable amount at Domira Bay and Balakas. Congestion in the trays, due to pupæ in the diapause stage, has necessitated an increase in the batteries of trays at the last three stations.

During the growing season the bollworm infestation was appreciably less than last year, probably owing to the more rigid enforcement of the two months' close season. A considerable amount of damage was, however, done to the crop. The writer of this section of the report only arrived in the country, from Barberton, in August, and so did not see the crop in the field at Domira Bay.

Larvæ were scarce at Domira Bay and Balakas in September, but were plentiful at Chiromo and Port Herald. A trip was made down the Lower River, in October, and green bolls and larvæ were absent, except on the marsh land where both were plentiful.

A randomised block experiment on uprooting dates has been started at Domira Bay and is proving useful in training new staff in field routine.

An experiment has been started at Port Herald and Domira Bay to determine the length of life, oviposition and fertility of the moths, especially during the close season.

There has been little emergence of moths at any station during October, and it is believed that the dry heat is responsible. In the Lower River area most of the larvæ die at once, if they are put in the cages in the day time, but if this is done in the evening a larger

number pupate. One tray at each station has been given a grass shade.

ROTATION CROPS.

BY

W. L. MILLER.

The maize crop has done well, averaging over 3,000 lbs. per acre. The selected native maize was tried again against Potchefstroom Pearl which, last year, was significantly better than the native. The difference was not significant, though both strains gave higher yields per acre, the native showing an improvement of 550 lbs. grain per acre at 2,900 lbs., and the Potchefstroom Pearl of 340 lbs. at 3,240 lbs. per acre.

The maize time-of-planting result has reversed previous trials in that the first planting was worse than some of the later ones. This is probably due to the fact that the first planting was, in effect, "dry planting", though this was not intended. Rain appeared to be imminent, but none fell for about a fortnight after planting. The highest yield was 3,660 lbs. grain per acre, January 6th planting, which declined to 1,450 lbs. for the January 26th planting.

Farm compost, at 4 and 8 tons per acre, was tried against wood ash at 1,000 lbs., and control. The ash treatment was significantly worse than the compost and control, and the 8-ton application significantly better than any other. There was no significance in the maize spacing trial, though the spacings at 3 feet, 2 and 3 plants per hole, gave the highest yields. A mass selected bulk of native maize outyielded a mass selected bulk of Potchefstroom Pearl by 665 lbs. grain per acre.

The groundnut crop was affected by dry weather in February. Yields were down from an average of a ton of unshelled nuts per acre, last season, to 1,300 lbs., which is nearer, but below, the normal average. There has been a keen demand for seed for export and local consumption. Adjacent lands have been taken into the station, increasing the area under cultivation by about $26\frac{1}{2}$ acres. This new clearing will enable a groundnut break to be included in the main rotation next year. Single-plant selections are being carried on with Virginia, Gambia and Barberton bunch, and several new introductions have been made.

Sorghums did well. Several short term dwarf varieties from Swaziland are very promising, though more susceptible to weevil damage than the long term native varieties.

Sesamum was grown for the first time at the Station. A $\frac{3}{4}$ -acre block yielded over 600 lbs. of good, white seed, most of which has

been disposed of to the Department of Agriculture for issuing to natives for seed.

Nine strains of Soya beans were grown; six of them will be carried on, but owing to poor yield and difficulty in harvesting, three have been discarded.

Green gram, Bambarra groundnuts and pennisetum were also grown.

CATTLE.

Three of the four bullocks have survived another year. They are in fair condition and able to do light work, such as ridging.

This is the most trying time of year (October–November) owing to great heat and poor feed, with the break of the rains the worst time for Tsetse fly. Injections of Antimosan (Bayer) were discontinued throughout most of the year, but have been started again for a short time, as the animals seem to be stimulated and improve in condition almost immediately. By experience gained with the first lot of bullocks, it is hoped to select suitable types for a continuation of the experiment next year.

The absence of a Veterinary Officer for the district, for part of the year, was felt very much.

INDIVIDUAL NATIVE HOLDING SCHEME.

A decision by which Government (represented by the Director of Agriculture) should undertake general responsibility for this scheme, was only reached in August. A 10-acre model holding has been laid out along the main road, near the village settlement. This holding will be run for two years with Station labour, and is intended to act as a demonstration to both individual native holders and passers by.

A six-course rotation will be used, including two years' rest under pigeon pea and bush growth. Cotton, maize, groundnuts and/or green gram and sorghum will be the main rotation, planted in $1\frac{1}{2}$ acre blocks and making 9 acres in all. One acre will be reserved for fruit trees, root crops, etc.

All intending settlers, for the time being, have moved into the village area and a borehole will be put down this year. Natives settled last year appear to have good stocks of food and any surplus in future can be taken over by the Station for feeding non-local labour.

BUILDINGS.

Staff increases necessitated an extensive building programme being undertaken this year, the required new buildings being three dwelling houses, with garages and boys' quarters, laboratory and offices. The

latter are contained in one building, and will complete a block along with the old offices.

Foundation digging was started early in April, and brickmaking as soon as it was evident that the rains had ceased, at the end of April.

When this report was written (November), one house had been roofed, the gables of the second were being built, and the third was slightly behind the second.

The brickwork of the offices and laboratory was then fully half-way up the window frames, and the work should be finished in ample time before the rains.

NIGERIA.

PROGRESS REPORT FROM THE CORPORATION'S SEED FARM, DAUDAWA, 1937-38.

BY
G. BROWNE.

This report covers the period from November 1st, 1937, to the 31st October, 1938, and is written as usual about halfway through the crop season.

CROPPING PLAN.

The cropping plans for the two seasons under review were as follows :—

MAIN FARM.

	1936-37	1937-38
Land Occupied by Settlers	105 acres	100 acres
Land left for Settlers' Extension (Grass)	35 "	40 "
Farm Buildings, Stores, Ginnery, etc.	5 "	5 "
Area under Cotton	379 "	282 "
" " Guineacorn	130 "	158 "
" " Mucuna Beans	20 "	10 "
" " Native Beans	10 "	10 "
" " Pigeon Peas	11 "	20 "
" " Sweet Potatoes	10 "	10 "
" " Grass	195 "	265 "
Total area of Main Farm	900 "	900 "

CO-OPERATIVE SITE.

Number of Settlers	6	10
Area of land occupied (estimated)	60 acres	100 acres

CROPS.

Cotton.—Last season the D.31 Strain was grown over the whole of the farm with the exception of 20 acres of E.31 and 10 acres of the permanent experiment of current strain *versus* B.C.G.A. Ordinary. The area actually planted in D.31 on the Main Farm was 349 acres, made up as follows :—Seed ex Maigana, 309 acres, and seed ex Bush Plots 40 acres. In addition, the Settlers' and the Co-operative Farms were all planted in D.31 ex Maigana, the total acreage being estimated at 211.

On the Main Farm planting commenced on June 28th and finished on July 22nd, a good stand being obtained and very little supplying being necessary. August and September proved to be good growing months, but the rains unfortunately finished on September 30th, and thus spoilt what might have been an extraordinarily good season. A certain amount of aphid, leaf curl and bollworm damage was

experienced, but not much more than could be expected in the circumstances. Some stem borer damage was seen in the E.31 strain, but practically no aphid, this cotton having a fairly hairy leaf. Flowering and fruiting were heavy in the latter part of the season, but some jassid damage later made itself evident in the earlier planted fields.

Picking commenced on December 7th, a fortnight or so earlier than usual, and ended on March 7th. Owing to the partial cessation of the harmattan, the cotton plants remained green longer than usual; boll opening was delayed, picking was easy and the cotton very clean. Three pickings were taken extending over three months.

As was expected, yields showed a great improvement on those of the previous year—which was admittedly a bad one—and 96,218 lbs. of No. 1 grade seed cotton and 924 lbs. of No. 2 grade were produced by the 379 acres under this crop, an average of 256 lbs. per acre, including No. 2. (This compares with an average yield of 127·7 lbs. per acre last year, but in this connection it may be recalled that, apart from bad climatic conditions last season, this season saw the beginning of the crop restriction scheme under which fields in poor heart are laid down to grass, and only the better ones planted in crops.) The highest yield per acre on the farm for any one field of 20 acres was 440 lbs. per acre, in a field which is always the highest yielder. The D.31 ex Maigana gave an average of 274·8 lbs. per acre, the D.31 ex Bush Plots, 179·2 lbs., and the E.31 194·8 lbs., whilst the experiment D.31 *versus* B.C.G.A. (on very poor land) gave: D.31, 112 lbs. per acre, and the B.C.G.A. Ordinary, 94 lbs. per acre. The Settlers' and Co-operative Farms together produced 28,935 lbs. of seed cotton, an average of 137·1 lbs. per acre. The estimate of the acreage at 211 acres is rather on the high side, as it is very difficult to estimate the acres of the more broken farms; the average yield is thus adversely affected. The highest yield on any one farm was 230 lbs. per acre; the price paid for No. 1 grade seed cotton—which is always on a par with local market prices—was 0·70d. to 0·80d. per lb.

Ginning commenced on January 25th. The E.31 strain, of which there was 3,855 lbs. of No. 1 grade seed cotton gave a ginning percentage of 31·29 per cent., whilst the D.31 from the permanent experiment showed a ginning percentage of 34·00 per cent. The B.C.G.A. strain from the same experiment showed a ginning percentage of 31·76 per cent. The hand pickings from the No. 1 grade seed cotton obtained during picking and ginning from the Main Farm and Settlers' farms amounted to 1,085 lbs., with a ginning percentage of 36·9 per cent. All the foregoing was ginned at Daudawa as was also a part of the bulk D.31, but the Agricultural Department again decided to have

the remainder of the D.31 ginned as a commercial sample at Funtua on the blast gins. The portion of the D.31 ginned at Daudawa weighed 18,959 lbs. and gave a ginning outturn of 32·21 per cent. The remainder of the D.31 ex Maigana seed cotton amounting to 94,014 lbs., which was ginned at Funtua, had an outturn of 34·54 per cent. The D.31 cotton ex Bush Plots was also ginned at Funtua, the weight being 7,168 lbs., giving an outturn of 33·10 per cent.

The D.31 lint ex Maigana and the D.31 ex Bush Plots which were ginned at Funtua was sent to England by the B.C.G.A. in 84 hard-pressed bales, while all the lint ginned at Daudawa was transported to Funtua in 49 light-pressed bales and forwarded in the same consignment. The brokers' report on the 38 bales of D.31 ex Maigana ginned at Daudawa was "Strict Good Middling, creamy in colour, Staple $\frac{7}{8}$ ", rather soft, value, 4·50d." The report on the 7 bales of E.31 lint, also ginned at Daudawa was rather better, being "Strict Good Middling to Mid-Fair, creamy in colour. Staple $1\frac{1}{8}$ ", strong, value 4·75d." The B.C.G.A. Ordinary from the permanent experiment of which there was 1 bale, was reported upon as "Good Middling, good colour. Staple 1" to $1\frac{1}{8}$ ", value 4·65 d." This was better than the other part of the experiment, *i.e.*, 1 bale of D.31—which gave a higher yield of seed cotton and lint on which the report was "Good Middling to Strict Good Middling, creamy colour, $\frac{7}{8}$ " to 1" weak, value 4·50d." The report on the 84 bales of D.31 ginned at Funtua, was "Strict Good Middling to Mid-fair. Staple about 1", strong but wanting in fineness, value 4·65d." All the above values were based upon June American Futures at 4·30d. per lb. In spite of the slight differences in value attributed to the various lints by the brokers, the whole of the different lots were sold at the same price, *viz.*, 5·10d. per lb.

The seed from the various ginnings referred to above was disposed of as follows:—D. 31 ex Maigana grown in bulk, was discarded as was also the E.31 seed and the seed from the experiments. The seed of D.31 ex Bush Plots was returned to Daudawa for planting during the present season.

Turning to the present season, planting began on the 16th of June, almost a fortnight earlier than last year. In view of the relatively small amount of cotton to be planted on the Main Farm this year, it had been intended to carry out a planting date trial again, but the poor incidence of rainfall precluded this and it became rather a question of getting the cotton planted in the best circumstances possible.

A conclusion that may be drawn on the basis of several years'

experience seems to be that, generally speaking, planting much before the end of June is not a success, so far as Daudawa is concerned at any rate.

The whole of the area to be planted in cotton on the Main Farm, with the exception of 40 acres and part of the permanent experiment, has been sown with D.31 seed ex Bush Plots grown at Daudawa last year. The Settlers' and Co-operative Farms, the estimated area of which is 199 acres, have also been sown with this seed. The 40 acres referred to above were planted with another strain of D.31, known at present as D.31 (AC). Seed rates were very low this year, and great care had to be exercised, especially as the earlier planting conditions were poor.

Germination was poor and great difficulty was experienced in establishing supplies in the earlier planted fields. This was due to the long periods without rain in early July, when actually cracks were seen in the fields. Conditions improved, however, and the later planted fields scarcely needed any supplies at all, thus making up for the heavy seed expenditure in the early part of the season. Though the aggregate rainfall during August and September was below average, the incidence was excellent, and the cotton made good headway during those months. The last rain, a useful one of half an inch, fell on October 5th, and did much to prolong the dews and help the crop along. At the time of writing this report—the end of October—the crop looks quite promising and wonderfully free from disease. Flowering and fruiting are heavy and yields ought to be good, provided all goes well for the remainder of the season.

Bulrush Millet.—This crop has been discontinued, with the exception of a small trial of Gold Coast millet, which was carried forward from last year. This year the crop has again been almost a complete failure and no further work will be done on it.

Guinea-corn.—As mentioned in last year's report, the first planting of the guinea-corn crop was more or less a failure, and had to be re-sown, though late in the season. Locusts also did some damage. Later, however, the crop made quite good progress and finally the 110 acres yielded 63,998 lbs. of threshed grain, an average of 582 lbs. per acre, the highest yield on a 20-acre field being at the rate of 656 lbs. per acre. This compares very favourably with the previous year when the general average was only 323 lbs. per acre.

In the current year 158 acres have been planted. It had not been intended to sow quite such a large area, but excessive locust damage on outlying Settlers' and Co-operators' farms indicated that there was likely to be a grain shortage, so more fields were planted on the

Main Farm. A certain amount of locust damage was experienced on some fields, but on the whole, the crop is the best yet seen at Daudawa; thinnings were used to make good the locust damage and suitable conditions allowed them to take root. Close spacing at 18-inch intervals was universally adopted. When ripe, the corn is cut short and stacked near the roadways, after which the threshing machine is taken round the fields, and the threshed corn later carted to the stores.

Sweet Potatoes.—The sweet potato crop yielded fairly well last year, producing 562 lbs. per acre. The crop is very useful on account of its excellent feeding value for cattle.

Difficulty was experienced again this year in obtaining seed, and only 10 acres have been planted, the bulk of the seed having to be bought. To obviate this in future, a small plot has been planted on spare ground and will be left over until next year for seed.

Mucuna Beans.—The mucuna beans planted last year did very well, the leaves being mixed with hay and used as cattle fodder. The seed was kept to sow the present season's crop. Ten acres have been sown and almost all the broad base terraces have been sown with it, with the idea of consolidation and protection from wash; it is thought that actually they are more effective as a protection from wash than as a consolidating medium.

Pigeon Peas.—About 15 acres of pigeon peas have been sown on a field which has been badly eroded. The runnels have been made up, the field terraced and pigeon peas sown and re-sown, until a good crop was ensured. It is proposed to leave them for two or three years in order to get some humus back into the soil.

English Potatoes.—The small trials carried out with this crop have not been very successful, but are still being continued, as it is thought probable that the poor results are due to lack of knowledge as to the correct times for planting and the conditions required. The main idea in attempting to get English potatoes established is to provide another fairly highly remunerative cash crop for the Settlers.

Haygrass.—A tractor trailer mower has been purchased and works most successfully. This year the cattle-drawn machine has been made to mow much higher with the result that there has been no trouble and it has cut an area about three times greater than before. Haymaking is still in progress, and to date over 100 acres have been cut and harvested. Some of the 195 acres that have been put down to grass this year will be left uncut for grazing. One noticeable feature this year has been the zest with which the cattle graze the newly-mown fields in order to get at the young grass, but as an attempt is being made

to establish really thick grass fields, excessive grazing is not allowed. Large quantities of selected fodder grass seeds have been collected for sowing down next year, and it is proposed to purchase harrows so that these grass fields can be properly levelled for mowing.

Experiments.—The permanent experiment of the current strain of cotton *versus* the ordinary B.C.G.A. Commercial is being continued.

As mentioned in last year's report, the second half of the trial to test the pan-breaking property of pigeon peas is in progress and the improved growth on those strips which last year were planted in peas is already evident to the eye. It will be recalled that last year, alternate one-acre strips were planted in cotton and pigeon peas; this year the whole area was manured and cotton planted over the entire field. When the crop is picked the yields of the various strips will be recorded separately and it will then be seen if there is any appreciable difference in yield between the areas planted in pigeon peas last year and in cotton this year, and those planted in cotton in both years.

A field trial to test the manurial and economic value of superphosphate when used (a) alone and (b) in conjunction with various dressings of F.Y.M. has been laid down on six adjacent two-acre blocks. A dressing of superphosphate at the rate of $67\frac{1}{2}$ lbs. per acre was applied to three of the six blocks, in the first instance alone, next in conjunction with 1 ton per acre of F.Y.M. and lastly with 2 tons per acre of F.Y.M. In the remaining three blocks, one was given a 2-ton dressing of F.Y.M. per acre, the next 1 ton of F.Y.M. per acre, and the last block was left as control.

Cattle.—Until recently, when prices have dropped, no attempt has been made to purchase cattle in order to increase the herd or make replacements. There are now 194 cattle in all, of which 119 are working bullocks, 29 breeding cows and 46 yearlings and calves. During the period under review 16 calves have been born and 3 of these have died. The Daudawa area is now free from fly, and there have been no deaths from trypanosomiasis. Ten animals have died or been killed, the causes being as follows:—Animals found unsuitable for work, 5; liver sclerosis, 3; broken leg, 1; and horn gore 1. The proceeds from the sale of the carcasses have replaced these animals.

The health of the herd is now eminently satisfactory. A good type of animal is being bought and it has always been found that it pays to follow this policy. The same applies to the cattle sold to the settlers apparently, for, with the exception of the beast with the broken leg, there have been no deaths among their cattle. One of the main reasons for this improvement in general health compared with a

few years ago is that the working hours have been greatly reduced and feeding improved, so that the cattle are never caught in a run-down state, in which their resistance is lowered so much that they are particularly susceptible to any disease.

ANTI-EROSION MEASURES.

A programme of broad-base terracing affecting 250 acres has been carried out during the past year and it is hoped to continue this work to a certain extent during the present season. An R.S.L.D.X. plough and a Fordson tractor did the greater part of the work after the contours were run, and the actual terracing was done by the tractor and a home-made grader, the work being finished off by hand. In those fields under crops, contour ridges were used, running as nearly as possible parallel to the terraces, but in land already slightly broken, this method has not been wholly satisfactory, as wash is caused in low places between terraces. It is thought that ridges with rather more slope than the terraces would be advantageous. Contour ridging without terraces has proved very satisfactory on unbroken fields with a slight slope. On the whole the anti-erosion measures taken have been very beneficial, but in the coming season certain variations will be tried.

Labour.—Supplies of labour have been satisfactory throughout the year and there has been no trouble from sickness or infectious diseases. Six people died in the camp during the year. As usual, local women and children have been employed in the busier parts of the season.

Settlers' Farms.—So far as the settlers on the Main Farm are concerned, the year has been one of consolidation and no new farmers have been set up. One farm is being worked by Corporation labour as the occupant became mentally deranged and had to go away. A new tenant will be found next spring. As regards the settlers on the Co-operative site, four new men have taken up cattle, thus making 18 settlers in all. Progress throughout the year has been excellent and there is a marked improvement in farming practice. Some men have gone in for contour ridging on their holdings as an anti-erosion measure. Every effort is being made to induce them to increase manure production; this is really the only direction in which their practice can be seriously criticised. Once they have grasped the value of manure, they will certainly make every effort to increase its production. There is already evidence that they are becoming more aware of its value and every opportunity is taken to illustrate to them any experiments or outstanding cases on the Main Farm, where the value of F.Y.M. is more than usually noticeable. Some of the farmers had

their millet and part of their guinea-corn crops eaten by locusts, and they are being helped out by the issue of grain where necessary. Otherwise their crops are good and their holdings in good order. With the exception of one animal that broke its leg, there have been no losses of cattle.

Water-works.—The system has worked very well during the year and there is nothing to report.

Buildings.—A new office has been built during the past year, but owing to the death of one of the masons, this work has taken longer than was expected. The office is in laterite and cement, with ceiling and pan roof. Work has now been resumed on the second permanent cattle pen, which was interrupted by the fire in the No. 2 Staff House last year.

Locusts.—Hoppers caused much damage to Settlers' and Co-operators' farms and to outlying portions of the Main Farm in the early part of the year, but although large swarms have been seen in the neighbourhood since, very little damage has been done.

Meteorological Notes.—Although the total rainfall was considerably below normal, being 39·02", compared with the average of 48·86" for the past 6 years, the incidence was very good, except in early July, which is the most important part of the cotton planting season. In this period there were lengthy dry periods when it was almost impossible to get young plants established. Latterly, growing conditions have been excellent, especially as the harmattan, which appeared soon after the rains ended, has now cleared away and the cotton and cereal crops look very well indeed. As mentioned previously, the October rains did not materialise, the only fall being on the 5th, whereas the nearer to the 20th October rains fall, the better the prospects for the cotton crop. There was a shower of 0·04" on 2nd November.

General.—The delegates attending the West African Agricultural Conference visited Daudawa in June.

Mr. A. E. Casement, the Manager's Assistant, returned to England in June on leave, and subsequently resigned to take up work at home. He has rendered admirable service during the seven years that he has been at Daudawa, and his departure is very greatly regretted.

In conclusion it is desired to extend the Corporation's thanks and appreciation for the assistance and co-operation rendered throughout the year by the Administrative, Agricultural and Veterinary Departments.

[Included by courtesy of the Nigerian Government.]

NIGERIA.

PROGRESS REPORT ON WORK ON COTTON IN THE NORTHERN PROVINCES FOR THE SEASON 1937-38.

BY
J. K. MAYO.

In the season under review growing conditions were normal at Zaria where the work herein described was carried out.

This work has consisted mainly of further trials of and re-selection in the strain D.31 which has figured largely in the two previous reports. Some derivatives of U.4 from South Africa and Uganda were tested for the first time.

Information has now been received that the 46 bales (see last report) of bulk D.31 grown at the Empire Cotton Growing Corporation's farm at Daudawa in 1936 were sold to a single mill in the summer of 1937 when American middling was 6·97d. per lb. The price paid was 7·72d. (a premium of 75 points) which is at least as high as that usually obtained for the commercial crop (sold under the mark N.A.1). The mill was well satisfied with the cotton for the use to which it was put, and asked for more.

Daudawa grew some 80 bales of the same cotton in 1937 which were sold in June, 1938, at 5·10d. when American Futures were 4·75d.

In the 1935-6 report it was said that, as D.31 was not a pure strain, attempts were being made to improve the quality without losing the yield. The original bulk gave increases of yield over the standard strain of 40%, but the yarn was 15% to 18% weaker than that from the standard. Recent trials have shown up three strains which give stronger yarn than this with varying yields:—

	1936	1937
D.5 (No. 5 in last report).	28% increase in yield; 1% decrease in strength.	26% increase in yield; 8% decrease in strength.
D.8 (No. 8 in last report).	52% increase in yield; 8% decrease in strength.	62% increase in yield; 5% decrease in strength.
D.30 (J in last report).	76% increase in yield; 6% decrease in strength.	32% increase in yield; 3% increase in strength.

As Northern Nigerian cotton is always in practice mixed with one or more other growths in the mills, it is doubtful if these variations in strength matter at all.

The question of growing a mixture of these strains, or of two of them, is under consideration.

The following are the details of a trial of introduced varieties :—

Layout	...	...	Randomised blocks
Repeats	...	...	10
Plot	...	...	One ridge 66 ft. × 3 ft.
Spacing	...	...	15" between stands on the ridge
Planted	...	...	5/7/37
Harvested	...	...	30/11, 20/12, 3/1, 2/2

Result.

Strain	Source and date of introduction	lbs. lint per acre.	Yield as % of standard	Ginning %
U4/64	...	185	76	31.3
U4/123	...	222	92	30.7
U4/4/2	...	191	79	35.0
U4.H77	...	178	73	30.7
U4.214	...	202	84	32.2
U4.C15	...	176	73	32.3
U4.29	...	189	78	33.2
SP 86	...	187	77	32.6
SP 87	...	213	88	35.0
Standard	...	242	100	31.0

Standard yielded 779 lbs. seed cotton per acre, which is high for Nigeria.

The trial was significant when $P = 1\%$.

A difference between any two strains to be significant must exceed 18.1 lbs. of lint per acre or 7.48% of standard.

Standard was therefore significantly better than all other strains.

The strains from Southern Rhodesia and South Africa may be expected to have passed the acclimatisation stage, but the two S.P. strains were experiencing their first growing season in Nigeria.

The Uganda strain S.G.27 which figured in previous reports has now had to be discarded owing to susceptibility to leaf curl and blackarm.

PROGRESS REPORT ON COTTON SELECTION WORK IN THE SOUTHERN PROVINCES, SEASON 1937-1938.

BY
O. J. VOELCKER.

During the 1937-38 season cotton selection followed closely the lines laid down and explained in previous reports. The two main features of this work on cotton selection are first, the maintenance of purity in Ishan A, and second, the attempt to improve the smoothness of lint in Ishan A by methods of backcrossing with Sea Island cotton advised by Dr. Harland.

The selection plot was situated on what proved to be rather poor land, but unlike the previous season, weather conditions were favourable, except for a shortage of rain during November and December. Although the plants generally had made satisfactory vegetative growth up to the end of October, the shortage of rain in

November adversely affected boll development. There was some indication that the earlier flowering strains of the backcrosses were consequently favoured, which, under more normal conditions, would not have been so. Routine examination of the plants was carried out in the field. Incidence of fungus and insect attacks were noted, together with such vegetative characters as leaf hairiness and node of the first fruiting branch.

MAINTENANCE OF ISHAN A.

Seventy-eight plants, the result of self-fertilized seed from a single selection in the previous year, were established. In October, a strict selection was carried out in the field and sixty plants were discarded. The remaining eighteen plants—on which all flowers were self-fertilized—were subjected to further selection on vegetative characters and laboratory tests, and from among these eighteen, the two best were selected. An examination for lint smoothness bore out the previous conclusion that there was little likelihood of finding an Ishan A possessing a really smooth lint. The following tables show the measurable characters of the two selected plants, and the average of all plants examined is given for comparative purposes.

SELECTED PLANTS.

	1937/38		1936/37		1935/36	
	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2
Halo Length (mm.)	31.1	30.9	32.2	33.3	31.25	31.3
Ginning Percentage	35.76	36.88	34.8	35.1	35.9	36.5
Number of Bolls	104	119	108	123	214	191
Weight of Seed Cotton (gms.)	150	133	164	189	462	361
Weight of Seed Cotton (gms.) per boll	1.44	1.12	1.51	1.53	2.16	1.89
Node of First Fruiting Branch	14	14	15	16	15	14

AVERAGE OF ALL PLANTS EXAMINED.

	1937/38	1936/37	1935/36
Halo Length (mm.)	30.29	32.9	30.16
Ginning Percentage	35.14	34.5	35.8
Number of Bolls per plant	59.90	48.0	112
Weight of Seed Cotton per plant (gms.)	79.27	66.0	207
Weight of Seed Cotton (gms.) per boll	1.23	1.32	1.74
Node of First Fruiting Branch	14.0	14.1	15.0

FIRST ISHAN A × SEA ISLAND BACKCROSSES.

These cottons are produced by the formula (Ishan A × Sea Island) × Ishan A, and 1,534 single plants were grown. None of these did well enough for direct selection, although in smoothness of lint they were mostly superior to Ishan A. Unfortunately they lacked desirable vegetative characteristics, chief of which are vigorous growth and leaf hairiness; without these a cotton would be unsuited to the conditions under which it would be grown on native farms in Southern Nigeria.

In view of this, it has been decided to retain this group of cottons as material for further local backcrossing only.

In the selection plot six rows, denoted AS1 — AS6, of this strain were established, and the best individual plants were backcrossed with Ishan A. Twelve rows, AS7 — AS18, were grown for further re-selection, and 41 rows, ASTD19 — ASTD59, of cotton of this formula received from St. Vincent were grown for observation. In accordance with previous experience, these ASTD cottons did not do well. Nine of these strains were discarded owing to their high susceptibility to disease; in addition they flowered too early. Actually none of the 41 ASTD strains did well enough for selection. As an example, it may be mentioned that the yield per strain and per plant was ridiculously low—averaging 3 to 4 gms. compared with about 79 gms. for Ishan A. In spite of this a few rows of ASTD cotton will be grown again for further observation.

SECOND ISHAN A $\times$ SEA ISLAND BACKCROSSES.

These strains are grouped together as having the same origin, being second backcrosses; viz.: cotton produced by the formula $[(A \times SI) \times A] \times A$. They are divided into two groups, ASX denoting the first progeny of the second backcross, and ASC the progeny of such crossing, which has been already self-fertilized for one season or more. Twelve rows, 312 plants, of ASC cotton were grown and 736 stands of the ASX group were established. As it is from this type of cotton that a new strain with a better quality lint is expected to be produced as an alternative to Ishan A, a very thorough lint test for smoothness was made on the 304 single plants (82 of ASC and 222 of ASX strains) selected in the field. This number was reduced to 24 after further field selection and laboratory examination of halo length and ginning percentage. Self-fertilized seed from these will be planted next year.

SUMMARY.

Ishan A underwent normal routine selection, the two best single plants supplying the seed for next year's planting.

Work on the attempt to improve the rough lint quality of Ishan by hybridization was continued. The results last season were encouraging, but it must be reported that too many selections of the previous selection season (1936-37) failed to show satisfactory lint character. The work will have to be continued for several more years before definite results are obtained.

WEST INDIES.

COTTON EXPERIMENT STATION, ST. VINCENT, PROGRESS REPORT FOR THE SEASON 1937-38.

BY

S. H. EVELYN.

GENERAL.

The cotton season opened on the 16th August, 1937, and an area of 4,900 acres was planted in the island, 54.6 per cent. of which was grown by peasants. Climatic conditions were, in general, excellent and with the exception of a severe attack of cotton leaf worm, which began in November and lasted until the first week of February, loss from pests was negligible. The leaf worm was kept under excellent control by dusting and spraying and only small areas, which did not receive prompt treatment, were severely damaged.

The growth of the crop was very good and a total yield of 1,730 bales of 400 lbs. each was obtained. The average yield of the Island was 141 lbs. of lint per acre, but at Diamond Estate, where the Island's seed supply is grown, a yield of 75 bales was obtained from 70 acres, an average of approximately 429 lbs. of lint per acre. Many of the estates averaged over 300 lbs. of lint per acre; the high yields are attributed to a combination of good weather conditions and the increased use of sulphate of ammonia.

A quantity of 80,800 lbs. of seed was obtained from the multiplication area at Diamond Estate and this is more than sufficient to meet the planting requirements for the season 1938-39.

The Station multiplication area yielded 1,155 lbs. of clean "selfed" seed which will be multiplied at Diamond Estate in the coming season.

COMMERCIAL EXPERIMENTS.

A randomized test of twelve V.135 progenies.—Twelve V.135 progenies, selected for high ginning outturn, were randomized in a 10-block "lay-out" with 5 plants per plot (see Hutchinson & Panse (1937)).

Observations were made for thirteen characters and the results were analysed by the analysis of variance.

Progenies 6, 7, 8 and 9 germinated poorly and as supplying was not done they were excluded from the analysis. The material used was considered very homogeneous and for this reason means of plots with missing plants were not corrected.

TABLE OF PLOT MEANS.

Character.	Strains.								Sig. Diff.
	V.1	V.2	V.3	V.4	V.5	V.10	V.11	V.12	
Germination ...	5.1	7.4	7.2	5.2	6.9	7.0	8.6	8.5	1.4
No. of days to flower ...	68.6	71.1	69.3	70.5	72.0	69.2	72.8	69.2	2.8
Plant height at maturity (cm.) ...	139.2	136.2	138.2	134.9	130.1	146.4	141.3	144.0	11.3
No. of bolls harvested...	80.2	66.6	69.3	62.8	61.1	73.5	67.0	66.3	14.4
Total wt. of seed cotton (gm.) ...	232.7	197.3	193.1	179.7	173.4	216.8	191.1	190.7	45.4
Total wt. of lint (gm.) ...	55.6	46.5	45.0	42.2	40.4	51.6	47.0	45.6	11.2
Total wt. of seed (gm.) ...	179.5	152.4	150.1	138.7	134.5	167.6	145.7	146.9	36.0
Seed cotton per boll (gm.) ...	2.86	2.87	2.82	2.86	2.78	2.95	2.86	2.85	0.16
Lint per boll (gm.) ...	0.68	0.67	0.66	0.67	0.64	0.70	0.70	0.68	0.04
Actual ginning outturn (%) ...	23.4	22.9	23.0	23.3	22.8	23.5	24.3	23.7	0.66
Ginning outturn (%) (sample of 100 seeds)	23.7	23.3	23.2	23.4	22.8	23.6	24.4	24.1	0.74
Lint Index (gm.) (sample of 100 seeds)	4.3	4.2	4.2	4.3	4.1	4.4	4.5	4.6	0.10
Wt. of 100 seeds (gm.)	13.9	14.0	13.8	14.2	14.0	14.4	14.1	14.3	0.36
Lint length (mm.) Mean of 5 measurements ...	58.2	58.4	58.2	58.4	58.2	58.8	58.5	58.2	0.60

Strains differed significantly in germination, number of days to flower, ginning outturn, lint index and weight of 100 seeds.

Standard errors of the differences between means of ten plots were in almost all cases low. The high error for total weight of seed cotton, and in consequence total weight of seed is due to variations in stand.

The above table demonstrates the advantages which the randomized progeny technique has over the old system. Small differences between strains which could not be relied upon in non-replicated progeny row work are shown to be significant by the new technique and may be subjected to selection with confidence. An example of this is supplied by the lint index means in the above table.

The mean ginning outturn per strain obtained from the total seed cotton per plant when compared with that obtained from a sample of 100 seeds of seed cotton per plant, differed very slightly. In all cases the "sample" mean was higher, but the maximum difference between any two means of the same strain was only 0.4 per cent.

Ten progenies have been selected for high ginning outturn and will be tested in the same way next season. In addition the twelve progenies grown this season will be re-tested in an eight block "lay out" in plots one hundredth of an acre in size.

Observations on commercially grown V.135.—An attempt was made this season to determine the variation which occurs between bolls and plants of commercially grown V.135. At Brighton Estate five hundred single bolls of various sizes were collected and analysed for weight of seed cotton, weight of lint, weight of seed, number of seeds, ginning outturn, and the mean lint length of three seeds per

boll. The results will be dealt with in a separate paper when the technological data are available.

In an attempt to study environmental variation in the crop as a whole, representative samples were obtained this season and sent for hair testing to the Shirley Institute. The samples were obtained in the following manner. From each consecutive lot of fifty bales ginned two bales were chosen at random from which 1 lb. samples of lint were extracted. In all fifty-nine samples were obtained, eighteen representing cotton grown by peasants and the remainder that produced on estates. Preliminary reports show a very high degree of uniformity.

A representative of the V.135 of 1928.—In 1928, the cotton Research Station at Trinidad obtained seed of V.135 from the progeny plots at this Station and subsequently perpetuated the type by grafts. In the 1936–37 season seeds of the graft were grown in St. Vincent and the plants appeared to be different from the present V.135. As this material offered a unique opportunity of testing the effects of selection after a period of almost a decade, a further lot of selfed seed of the graft was obtained and grown this season. Compared with standard V.135, the plants were stockier and more bushy. The bolls were smaller and somewhat rounded. The lint length was 4 to 5 millimetres shorter but the ginning outturn was about six per cent. higher, owing to a higher weight of lint per seed and a lower seed weight. Selfed seed was obtained from these plants and next season ten progenies will be compared with the ten V.135 selections in family blocks.

The following frequency arrays of the lint lengths of V.135 demonstrate the improvements which have been made. The frequency arrays for 1928 are the measurements made on the plants which were grown at this Station in the 1936–37 season from seed of the 1928 graft. The measurements were treated by the analysis of variance and the results which are recorded show that the variation between plants has been reduced.

FREQUENCY ARRAYS OF LINT LENGTHS OF V.135 PROGENIES.

Measurements in millimetres.																														
Year.	41	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	No.	Mean.	
1928							1	1	6	14	23	25	34	43	52	53	28	15	5									300	55.25	
1929	1	1	3	5	9	6	4	15	18	22	37	36	66	87	69	72	63	23	12	3	2	1							555	54.66
1930											2		1	10	17	100	211	162	157	101	75	43	7	3					895	59.34
1931													2	11	45	83	95	78	51	27	6	2							400	59.20
1932												1	2	13	8	42	47	33	15	18	17	3		1					200	58.49
1933														6	95	108	105	125	111	69	24	11	1						655	59.60
1934														19	69	95	132	118	139	136	60	29	9	1	2		1	810	60.45	
1935														3	39	50	54	36	49	29	13	2							275	59.53
1936														1	24	37	23	26	26	12	10	1							160	59.44

ANALYSIS OF VARIANCE OF LINT LENGTHS OF V.135.

Year.	Between Plants.			Between Seeds.				Mean Length (mm.)	S.E. as %ge. of Mean.
	Degrees Freedom	Mean Square	P	Degrees Freedom	Mean Square	Standard error	S.E. of 5 measurements		
1928	29	18.72	<.01	270	4.15	2.04	0.91	55.3	3.69
1929	110	40.31	<.01	444	3.97	1.99	1.26	54.7	3.64
1930	178	6.96	<.01	716	2.71	1.65	1.04	59.3	2.78
1931	79	6.69	<.01	320	1.63	1.28	0.81	59.2	2.16
1932	39	6.50	<.01	160	3.74	1.93	1.22	58.5	3.30
1933	130	6.27	<.01	524	2.62	1.62	1.02	59.6	2.72
1934	161	8.23	<.01	648	3.13	1.77	1.12	60.5	2.93
1935	54	6.54	<.01	220	2.51	1.58	1.00	59.5	2.65
1936	31	5.44	<.01	123	2.85	1.69	1.07	59.4	2.84

The progenies grown at the Station in 1929 constituted the material on which selection was practised.

The Red Sea Island Progenies.—In 1930 four families of a second backcross of Trinidad Red Kidney, a perennial Barbadosense, $\times$ Sea Island Crinkled was sent to this Station from the Cotton Research Station at Trinidad. This work, which was started by Dr. S. C. Harland, had as its object the transference by repeated backcrossing of red body-weak corolla spot, from Trinidad Red Kidney to Sea Island.

The material sent from Trinidad had many undesirable characters, such as crinkled leaf from its Sea Island parent and the monopodial habit from its perennial parent. In its first season in St. Vincent a single plant was found which possessed a lint length of 57 mm. in combination with a red plant body and weak corolla spot. This was selfed and is the original parent of all subsequent selections.

In parallel, repeated backcrossing was carried on but the material obtained was definitely inferior to that obtained by selection in the selfed products of the second backcross and was therefore discarded.

By 1934 the material was homozygous for red plant body-weak corolla spot and extra-superfine lint length. Its measureable hair characters were tested against V.135 in 1934 and showed no differences, but spinning tests showed its strength to be slightly inferior to that of V.135. It was again tested in 1938, and was found to have the hair weight and spinning value typical of "ordinary" and not "superfine" Sea Island.

In germination and such yield characters as seed cotton per boll, lint per boll, seed weight and ginning outturn Red Sea Island is superior to V.135 but in bolling it is not as good.

This season thirty-eight Red Sea Island progenies selected for ginning outturn, lint index and bolling were grown in single rows of 20 plants. Increases in the selected characters were obtained and twelve progenies are being carried forward.

The V.135 $\times$ Montserrat Sea Island Hybrids (VH progenies).—It

is now well recognised in St. Vincent that yields of over a bale an acre can be obtained from V.135 when it is grown in suitable environments and receives adequate cultivation and manuring. More often than not, however, V.135 is planted in unsuitable situations, is not manured at all and receives little cultivation. Under such conditions yields are low, and it was for this reason that an attempt was made to produce a strain combining the high yielding qualities of Montserrat Sea Island with the lint characters of V.135.

The two strains were crossed and a backcross was made to the Montserrat Sea Island parent. From this backcross plants with high lint indices were selected. The products of repeated backcrossing failed to compete with those obtained by selection from the first backcross, and were discarded.

This season, after five generations of selfing and selection, thirty-seven progenies, fourteen of which possessed intermediate and short staples, were grown and analysed. The intermediate and short stapled strains proved inferior to Nevis and Montserrat Sea Island and were discarded. The long stapled strains showed much variation in lint length and did not appear to be as promising in agricultural characteristics as Red Sea Island ; a spinning test, however, showed this year that they were superior in quality.

Ten selections were made and will be tested for one more season, in randomized plots each of five plants. Each selection will be replicated ten times.

A randomized test of three progenies of each of the strains V.135, Red Sea Island and VH.—The “family block” design was employed for this experiment. (See Hutchinson & Panse, 1937.) Observations on fourteen characters were made and the results were analysed by the analysis of variance. Only results for “main” strains are reported.

TABLE OF MAIN PLOT MEANS.

Character.	Strains.			
	V.135	RSI	VH	Sig. Diff.
Germination	46.1	71.0	65.4	6.6
No. of plants to flower at 68 days	15.0	13.6	12.6	7.3
Plant height at maturity (cm.)	128.3	143.1	116.6	13.2
Number of bolls at maturity	57.5	52.6	48.8	14.4
Number of erect plants at maturity	11.2	8.8	8.4	8.6
Total weight of seed cotton (in $\frac{1}{4}$ ozs.)	563.8	540.5	496.2	193.0
Total weight of lint (in $\frac{1}{4}$ ozs.)	130.0	146.5	139.4	53.4
Total weight of seed (in $\frac{1}{4}$ ozs.)	442.6	399.7	366.5	138.0
Percentage stained seed cotton on total seed cotton	7.0	8.1	5.2	2.0
Weight of “white” seed cotton (in $\frac{1}{4}$ ozs.)	532.5	502.2	479.8	182.0
Weight of “white” lint (in $\frac{1}{4}$ ozs.)	122.7	137.0	133.9	50.0
Ginning outturn (on “white” seed cotton) (%)	23.0	27.3	27.9	0.8
Ginning outturn (on sample of 300 seeds) (%)	23.6	27.7	28.5	0.9
Lint index (on sample of 300 seeds) (gm.)	4.3	6.0	5.4	1.6
Weight of 100 seeds (on sample of 300 seeds) (gm.)	14.1	15.7	13.5	0.5

Strains differed significantly in germination, plant height, percentage of stained seed cotton, ginning outturn, lint index and weight of 100 seeds.

With the exception of stained seed cotton, significant differences between strains were in favour of Red Sea Island. Lint samples from this experiment were sent to the Shirley Institute for reports on the hair characters and spinning value. The results are discussed in a later section of this report.

It has long been recognised that V.135 suffers from two main disadvantages—a low ginning outturn and a tendency to “ whip over ” under a heavy top crop. Red Sea Island has a higher ginning outturn and under normal conditions, owing to its stronger scaffolding, stands up better under a heavy top crop. Observations on erectness were made this season but differences between strains were not significant.

The VH strain did not show up very well in this experiment, its only marked feature being its ginning outturn which, however, is not significantly better than that of Red Sea Island.

The Montserrat Sea Island Strain.—For various reasons the market for V.135 is more restricted than that for other Sea Island strains and attempts are consequently being made to find a substitute for it which would be more readily saleable and would give, at the same time, a sufficiently higher yield to compensate for the premium which V.135 commands.

The Monserrat strain appeared to fulfil these requirements and so was introduced and tested by the Department of Agriculture. As it was considered that the St. Vincent environment might affect the characters of the strain, this Station was asked to co-operate in an attempt at acclimatizing seed for the use of the Department of Agriculture in its trials.

Pedigreed seed of the two best progenies was obtained in 1935 and grown in progeny rows. Selection for lint index and ginning outturn was practised and this season a sufficient quantity of selfed seed was available to plant a small multiplication area at the Station. Analysis of the progeny rows grown this season revealed a decrease in the lint index and ginning outturn and an increase in the staple length and seed weight. Analysis of the multiplication area from the same seed did not show this, but a lint sample from it which was sent to the Shirley Institute for a spinning test gave a hair weight per centimetre of over 140 as compared with 117 which is the standard for Montserrat Sea Island.

The Agricultural Department's trials have now been running for

two seasons. Freshly imported seed has been used exclusively and the results indicate that the Montserrat strain, because of its higher ginning outturn, will significantly out-yield V.135 in lint per acre particularly under fairly dry conditions. Under wet conditions it appears to be more prone to shedding and boll diseases. It would appear from these results that the Montserrat strain is a promising substitute for V.135, but in view of the high hair weight of the Station sample, commercial production would be extremely risky. Station seed is being sent to Montserrat to be tested against local seed and meanwhile observations on environmental effects are being continued in St. Vincent.

A summary of the results of the hair and spinning tests carried out by the Shirley Institute on the Sea Island cotton samples submitted this year by the St. Vincent Station.—The following samples were submitted for testing at the end of this season. (A) Two control samples of V.135 obtained from the multiplication area at Diamond Estate. (B) Two hundred single-hole samples of commercial V.135 obtained at random from Brighton Estate. (C) Eight single plot samples of each of the three substrains of V.135, Red Sea Island and VH obtained from the replicated trial in which they were tested. (D) Eight single plot samples of each of the strains V.135, Montserrat SI, Barbados SI, Nevis SI, AN, BD, OSI and SIW, obtained from the replicated trial in which they were tested. (F) One sample of the Montserrat SI strain which had been grown in St. Vincent for two successive seasons. Results of the hair tests are available for samples A, D and F and these samples have also been spun on the ring frame. They will also be spun on the mule and a separate report made on the yarns obtained.

RESULTS OF THE HAIR TESTS.

Sample	No. of Samples	Length Characters				Immaturity		Mean Hair Wt. per cm. (10 ⁻⁵ mgm.)	
		Mean Length (32nds in.)	Effective Length (32nds in.)	% Dispersion	% Short Hairs	% Normal Hairs	% Dead Hairs		
(A) V.135 Diamond Estate	2	41	65	28	40	53	16	107	
(D) V.135 Sub-strains	V.1 ...	8	42	62	26	32	42	16	103
	V.2 ...	8	42	63	26	34	50	17	102
	V.3 ...	8	41	64	25	35	57	12	108
Red Sea Island Sub-strains	R.1 ...	8	36	60	31	43	52	17	128
	R.2 ...	8	38	61	30	40	55	11	126
	R.3 ...	8	38	61	29	39	54	12	126
V.135 Mont. Hybrids	VH.1	8	41	62	26	35	59	13	135
	VH.2	8	42	62	25	31	53	15	128
	VH.3	8	39	61	26	37	57	13	120
(F) Montserrat S.I. Strain ...	1	40	56	22	29	50	18	145	

The V.135 substrain V.3 gave a mean result very similar to the control samples from Diamond Estate. V.1 and V.2 had slightly lower effective lengths than Diamond Estate V.135. All V.135 samples were similar in hair weight and maturity. The Red SI substrains, R.1, 2 and 3, were slightly shorter and considerably coarser than V.135, but were similar in maturity. The hybrid substrains to V.135, VH.1 and VH.2 were similar in measured hair characters to the Red SI substrains. VH.3 had, however, a slightly lower hair weight than VH.1 and VH.2 but was still considerably coarser than V.135.

The Montserrat strain was by far the shortest and coarsest sample.

As regards the spinning tests, in the card and comber the V.135 samples appeared very neppy. The Red SI samples were rather less neppy, whilst the VH samples and those of the Montserrat strains were the best in this respect. In the succeeding processes many of the samples—particularly Diamond Estate V.135—gave trouble due to licking round the drafting rollers, involving numerous piecings which probably adversely affected the appearance and regularity of the yarns. Spinning was, on the whole, satisfactory, in view of the fact that the counts spun were very high for the ring frame.

The strongest yarns were given by the Diamond Estate V.135 samples. Next in order of strength, but considerably weaker, were the V.135 substrains. Of these V.3 was the strongest and V.1 the weakest. The V.135 Montserrat hybrids were weaker still, VH.2 being rather stronger than VH.1 and VH.3. The Red Sea Island strains were weaker again and barely as strong as the Montserrat strain.

None of the samples was equal in strength to the Diamond Estate V.135, which was, however, very neppy. Most of the other samples also suffered from neppiness, with the exception of the Montserrat strain—the only sample to give really satisfactory yarns. The Red SI strains were poor in appearance and weak, being barely equal in strength to the Montserrat strain.

A randomized test of eight Sea Island strains.—This season, in continuation of the policy of finding a substitute for V.135, seven Sea Island strains were tested against it in randomized plots replicated eight times.

Each plot consisted of three rows four feet apart and each row contained five plants spaced two feet apart. The strains used in the experiment were the commercial cottons of St. Vincent (V.135), Montserrat (MSI), Barbados (BSI), and Nevis (NSI) and four Sea Island cottons AN, BD, OSI and SIW, all of approximately the Montserrat strain length, which were isolated many years ago by

Harland in St. Vincent, and have since been maintained in pure culture at this Station.

Observations were made on the following characters and the results were analysed by the analysis of variance.

TABLE OF PLOTS MEANS.

Characters	Strains.								
	V.135	MSI.	BSI.	NSI.	AN.	BD.	OSI.	SIW.	Sig. Diff.
Germination (No. of seedlings) ...	34.9	32.6	22.9	40.3	35.9	37.4	43.3	42.8	2.64
No. of plants to flower at 66 days ...	12.9	9.4	10.6	12.9	12.4	12.6	13.8	13.9	1.68
No. of erect plants at 170 days ...	6.5	11.3	6.8	8.6	7.4	2.5	6.0	8.6	2.88
Total wt. of seed cotton ($\frac{1}{2}$ ozs.) ...	373.5	298.1	316.8	329.4	254.9	311.1	223.9	327.9	46.60
Total wt. of lint ($\frac{1}{2}$ ozs.) ...	86.0	96.5	74.4	88.1	77.8	82.5	68.5	98.4	13.20
Total wt. of seeds ($\frac{1}{2}$ ozs.) ...	290.5	203.9	245.0	241.8	176.9	230.9	155.9	230.8	32.40
Ginning Outturn (%) (White seed cotton) ...	23.1	32.5	23.4	26.9	30.9	26.6	30.6	30.4	0.50
Wt. of "white" lint ($\frac{1}{2}$ ozs.) ...	82.9	93.5	72.3	85.9	75.8	80.1	67.1	94.1	12.90
Percentage stained seed cotton ...	4.6	4.3	3.8	3.7	3.6	4.0	3.1	6.1	1.59
Seed cotton per boll (sample 300 bolls) (gm.) ...	2.98	3.93	2.44	3.14	2.74	3.54	2.78	3.25	0.18
Lint per boll (sample 300 bolls) (gm.) ...	0.72	1.30	0.60	0.86	0.87	0.97	0.87	1.00	0.05
No. of seeds per boll (sample 300 bolls) ...	16.5	18.8	14.7	17.9	16.6	19.3	15.4	17.0	0.91
Lint Index (sample 300 seeds) (gm.) ...	4.4	6.9	4.1	4.8	5.2	5.0	5.7	5.9	0.14
Wt. of 100 seeds (sample 300 seeds) (gm.) ...	13.7	13.9	12.5	12.7	11.3	13.3	12.5	13.2	0.38
Ginning outturn (%) (sample 300 seeds) ...	24.2	33.1	24.7	27.4	31.6	27.6	31.3	31.0	0.63
Lint Length (Mean of 5 measurements) (mm) ...	58.3	51.8	56.2	54.6	50.9	51.6	51.5	47.8	0.77

In almost all cases standard errors of the differences of means of eight plots were low. Differences between strain means were significant for all characters.

In the long-stapled strains BSI was generally inferior to V.135 and Nevis Sea Island. The latter on account of its good germination, high ginning outturn and excellent spinning qualities, is a potential substitute for V.135 if under St. Vincent conditions its staple length can be increased without detriment to those characters.

In the shorter stapled cottons the Montserrat strain was superior to the others, except in germination and earliness to flower.

The Gambia $\times$ *V.135 Hybrids*.—In 1936 a cross was made between V.135 and Gambia—a sympodial perennial type—in an attempt to increase the yield of V.135 by introducing useful characters, such as high bolling, from the Gambia parent.

This season 123 plants of a first backcross to V.135 were grown. They varied greatly in almost all characters but particularly in habit

of growth, boll size, number of bolls and type of seed. The lint was generally a dirty white and appeared to be very weak. The analytical results were so disappointing that the experiment was abandoned.

The Asiatic × U.4 Hybrids.—A section of the programme of work at this Station has, since 1933, been devoted to the isolation of early maturing, hairy selections which would be likely to be of value to countries in which jassid is a serious pest.

For this purpose selfed extracts of a fourth backcross (Asiatic × New World) × U.4 were obtained from the Cotton Research Station at Trinidad and grown in pedigree culture. This material seemed to hold out the greatest promise of success.

Under St. Vincent conditions the selected hybrids have in every season been superior to standard U.4 in earliness, yield characters and lint qualities, but whenever they have been tried in Africa in jassid infested areas, they have failed. It was therefore concluded that the St. Vincent environment was unsuitable for the continuation of this work and at the end of this season it was given up.

At the request of the Corporation's staff in Nyasaland a series of F_1 s was made between their best strains (C.28 and Z.14) and the best of the Asiatic × U.4 hybrids. These together with seventy-one single plant selections from the hybrid material were sent to Nyasaland this year for trial.

GENETIC EXPERIMENTS.

The investigations on the inheritance of leaf callus spot and kidney seeds in Sea Island cottons have been concluded. The results are being prepared for publication. The work on fuzzed seeds and boll loculus number in Sea Island cottons and that on the semi-sterile mutant of V.135, is being continued.

MISCELLANEOUS EXPERIMENTS.

The relation between boll position and lint length in V.135 and Enan's Brown Egyptian.—Five plants of each of the above strains were grown this season and the age and position of each boll of each plant was recorded. At maturity the seed cotton of each boll was sent separately to the Shirley Institute for testing the effect of the age and position of the boll on lint characters. This work is being carried out at the request of the Cotton Research Station at Trinidad.

The Type Plot.—As in past years, a collection of 300 types of cottons was grown at the Station. It has, however, been decided that in future, owing to an increase in the work on commercial breeding problems, the type collection will consist only of Sea Island and other Barbados cottons.

Buildings.—A concrete building was erected this year at the Government Ginnery for storing the Island's planting seed. Formerly this seed was stored in the main building of the Ginnery, which is constructed of wood, and so ran the risk of being destroyed by hurricanes or fire.

With financial help from the Empire Cotton Growing Corporation, the Government erected a reinforced concrete building this year to house the staffs of the Agricultural Department and the Cotton Experiment Station. The housing of these departments under one roof should go a long way towards furthering the excellent co-operation which already exists between them.

Acknowledgements.—The willing co-operation of the Department of Agriculture, the Government and the local cotton planters in the work of this Station is gratefully acknowledged.

The Cotton Officer would also like to record his appreciation of the continued excellent service rendered him by his Assistants, without which the programme of work, which was greatly increased this season, could not have been concluded.

(Included by courtesy of the Fiji Government.)

FIJI

COTTON EXPERIMENT STATION, SIGATOKA, PROGRESS REPORT FOR THE SEASON 1937-8.

BY

D. A. DONALD.

SEASON.

The cotton year in Fiji is from October to September. The "wet" and "dry" seasons are not regularly well defined. The heavy rains may commence as early as October or be delayed as late as February, and may be said to cease as early as March or continue to June. Recent experience has shown, however, that cotton planting as early as October/November is to be recommended. If preparation is delayed till the onset of the rains, it may not be possible to prepare an adequate area before February/March and the risk of losses due to cotton maturing during wet weather does not offset the losses due to reduced area.

The season under review commenced very well; precipitation was adequate, and crops planted October/December made good growth. On 26th February the North Western side of the island was visited by a severe storm which did considerable damage to all early planted crops and reduced the total crop by half. It was noticed that as a result of the storm many plots of Sea Island cotton failed to recover, while Backcross 172 proved much hardier. Plants that had already set fruit and were stripped bare, put on new growth and eventually produced quite heavy crops, though the plants were only half the normal height for the variety. The total rainfall for the period October/September was 7,974 points on 143 days:—1,100 points above the average at the Station.

BREEDING AND SELECTION WORK.

This year's selections were all influenced by the likelihood of Government deciding to issue only Sea Island seed for commercial production. Thus, whereas in the past selection has been based upon the Egyptian Sakel type of cotton, this year selection has been based upon the Sea Island type, while retaining as far as possible the robust plant habit of the Backcross. Some very promising selections have been obtained.

Kidney × *Sea Island* BX172.—The three selections from the 1936/37 progeny rows were planted in increase plots this season. The 172/23 plot was badly damaged by the storm and the flooded river kept the field waterlogged, resulting in failure of the crop commercially. Sufficient seed was harvested for further trial. The other two selections 172/32 and 172/39 proved rather harsh and coarse with a mean lint length of only 45 mm. and have been discarded.

From this season's progeny rows two selections have been retained for further trial. The particulars for 172/23/1, which is approximated by 172/23/5, are:—Lint length 50 mm.; lint index 5·00; ginning percentage 31·5 and yield of seed cotton per acre 1,354 lbs.

Of fifty single plant selections made during the season ten have been retained for progeny rows in 1938/39. The two most promising are:—

	172/23/1/4.	172/23/1/5.
Lint length	52 mm.	50 mm.
Lint index	5·25 grms.	5·33 grms.
Ginning percentage	27·5	31·5
Seed cotton per acre	2,119 lbs.	2,304 lbs.

In furtherance of the aim to secure a typical *Sea Island* lint and retain the *Backcross* plant habit, two second backcross plants, one recessive and the other dominant, were backcrossed with *Sea Island* during 1936–37 and planted in progeny rows in the season under review. The F_1 resulted in robust, upright, uniform plants resembling BX 172.

The seed cotton analysed as under.

	Dominant.	Recessive.
Lint length	53 mm.	50 mm.
Lint index	5·15 gm.	4·67 gm.
Ginning percentage	28	27
Yield per acre... ..	1,184 lbs.	663 lbs.

It is proposed to continue work with the dominant.

CULTURAL.

Spacing trial with Backcross 172.—This trial was repeated for the third time this season. Randomized blocks of $1/5$ acre each, on a Latin square layout, were again employed and the results for the three seasons are given below.

Yield of seed cotton per acre.

	1935–36	1936–37	1937–38
3 × 3 ft.	1,087·50 lbs.	881·25 lbs.	898·00 lbs.
5 × 3 ft.	811·78 "	542·50 "	694·00 "
5 × 4 ft.	644·89 "	345·00 "	496·00 "
6 × 4 ft.	718·08 "	400·00 "	478·00 "
Probable error	± 129·95 "	± 140·99 "	± 112·88 "
P.E. per cent.	15·93%	13%	17·59%

For the third successive season the 3 ft. × 3 ft. spacing gave the significantly greatest yield. The proportion of stained to white lint

was not significantly greater in the close spacing. The results for the three seasons are regarded as conclusive, and the experiment will not be repeated this season.

Mixed Cropping Trial—Cotton/Legume.—This experiment with the usual Latin square layout using BX172 cotton interplanted with cowpea, soya, peanut and mungh, cannot be regarded as conclusive owing to excessive storm damage and the use of a not very suitable field.

SEA ISLAND.

An acre plot of the ordinary Sea Island bulk was grown for selection and the raising of pure line bulks for seed distribution.

MONTERRAT SEA ISLAND.

From a small sample of seed of this cotton about twenty-five plants were raised for observation and the remainder of the seed was held over for the normal planting season.

HARVESTING.

The harvesting method mentioned in last year's report, whereby white and stained cotton is picked into separate bags for the first three pickings, was again employed with success at the Station. A number of growers have adopted the idea and state that it has saved a lot of unnecessary handling and picking over of seed cotton.

PESTS AND DISEASES.

Cutworm damage to young seedlings was extensive in the early part of the season.

Tipworm appeared early and retarded vegetative growth, causing in some instances very heavy shedding of the first setting of bolls.

Pink bollworm was more noticeable this season but damage remained slight.

Stainers appeared towards the end of the season, but caused little staining.

Crops at the Station were almost free of jassid attack and blackarm was noticed on very few plants.

STATION PROGRAMME—1938-39.

1. Selections 172/23/1 and 172/23/5 to be grown in increase plots.
2. Ten single-plant selections of BX 172 to be grown in progeny rows.
3. The F_2 of the third Backcross to be planted for further selection.

4. A small bulk area of the BX 172 will be grown to maintain the variety.
5. A Bulk Sea Island plot to be grown for selection and multiplication of pure line.
6. Cotton/legume intercropping trial.
7. Montserrat Sea Island will be grown in an observation plot.

GENERAL.

The single unit ginnery again gave very satisfactory results. It is confidently expected that the next good cotton season will necessitate the erection of one or possibly two more one-unit ginneries to save transport.

The interest of the small agriculturalist in cotton has been maintained despite adverse conditions and a further increase in the number of growers is recorded. Approximately 20% of the growers were Fijians.

It has been decided that for the 1938-39 season only Sea Island cotton will be grown in Fiji. Thus the Backcross 172 will not be grown in the Western District this year, except at the Experiment Station for maintenance of the variety.

EMPIRE COTTON GROWING CORPORATION

King's Buildings, Dean Stanley St., Millbank, London, S.W.1.

List of Publications issued to date. Those still in print can be obtained direct from the Corporation at the above address. Those out of print are marked with an asterisk. The prices include postage.

GENERAL AND TERRITORIAL

- "Cotton Growing within the British Empire and The World's Capacity for Consuming Cotton Goods." J. W. McConnel. 1921. Price 2s.
- "Cotton Growing in Nigeria." Sir Hector Duff. 1921. Price 2s.
- "The Extension of Cotton Cultivation in Tanganyika Territory." Major Hastings Horne. 1922. Price 2s.
- *"Cotton Cultivation in Nyasaland." H. C. Sampson. 1922.
- "Cotton Growing in South Africa." G. F. Keatinge. 1923. Price 2s.
- *"Cotton Growing within the British Empire." L. G. Killby. 1924.
- "A Cotton Research Station for the British Empire." Professor J. B. Farmer and Mr. L. G. Killby. 1925. Price 2s.
- "Report on the Cotton-Growing Industry in Uganda, Kenya, and the Mwanza District of Tanganyika." Col. C. N. French. 1925. Price 1s. 3d.
- "Memorandum by the Mechanical Transport Sub-Committee." Mr. G. H. Baillie, Mr. R. H. Brackenbury, Col. C. N. French. 1925. Price 2s.
- "Report on the Cotton-Growing Industry of Nigeria, 1926." Col. C. N. French. 1926. Price 2s.
- *"The Principles and Practice of Yield Trials." F. L. Engledow and G. Udney Yule. 1926.
- "Report on Suitable Rotation Crops for Cotton." H. C. Sampson. 1927. Price 1s.
- "Cotton Growing in Southern Africa and the Rhodesias." Report on a Tour undertaken by Sir James Currie, Mr. J. S. Addison, and Mr. H. C. Jefferys. 1927. Price 2s.
- *"Reports from Turkestan Plant Breeding Station, Tashkent." 1928.
- "Review of the Situation in the Principal Cotton-Growing Territories of the Empire, and a Summary of the Main Activities of the Corporation since their Formation." 1928. Price 9d.

* Out of print.

LIST OF PUBLICATIONS—*continued*.

- "Report on Cotton Breeding and Seed Supply in Nigeria, 1928." F. L. Engledow and C. N. French. Price **2s.**
- *"Conference of Workers on Cotton Growing Problems, held August, 1930." Papers and Discussions. Price **2s. 6d.**
- "Conference of Workers on Cotton Growing Problems, held July, 1934." Papers and Discussions. Price **2s. 6d.**
- "The Principles and Practice of Field Experimentation." J. Wishart and H. G. Sanders. 1935. Price **3s.**
- "Cotton Pest Control Work in Southern and Central Africa and the Rhodesias." J. W. Munro. 1937. Price **2s. 6d.**
- "Conference of Workers on Cotton Growing Problems, held September, 1938. Report of Proceedings and Papers Submitted. Price **2s. 6d.**

REPORTS RECEIVED FROM EXPERIMENT STATIONS.

Seasons 1923, 1924 and (South Africa only) 1925. Price **2s.** The following volumes are obtainable at **2s. 6d.** each: Seasons 1925-26, 1926-27, 1931-32, 1932-33, 1933-34, 1934-35, 1935-36, 1936-37, 1937-38. The remaining volumes are now out of print.

REVIEW OF THE WORK OF THE EXPERIMENT STATIONS.

Seasons 1933-34, 1934-35, J. C. Willis; 1935-36, 1936-37, W. Nowell; 1937-38, W. Nowell and J. W. Munro. Price **1s. 6d.** each.

MEMOIRS OF THE COTTON RESEARCH STATION,
TRINIDAD.

Price **2s. 6d.** each.

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